
SUMMARISED REPORT

ON THE

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BOMBAY PLAGUE RESEARCH LABORATORY,

FOR 1896-1902, , 1902-04.13

BY

W. M. Haffkine

W. M. HAFFKINE, C.I.E.,

DIRECTOR-IN-CHIEF.

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No. ¹/_{S.C.} OF 1903.

FROM

W. M. HAFFKINE, Esq., C.I.E.;

TO

THE SECRETARY TO GOVERNMENT,
General Department.

Plague Research Laboratory,

Parel, Bombay, ^{4th}/_{21st} March 1903.

SIR,

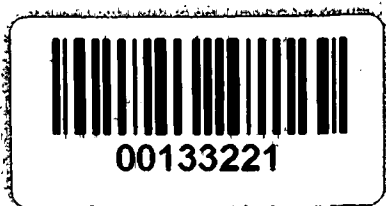
I have the honour to forward, for Government's favourable consideration, attached Summarised Report on the working of this Laboratory from the 8th October 1896 till the 31st May 1901, and for the year following.

I have the honour to be,

Sir,

Your most obedient Servant,

W. M. HAFFKINE,
Director-in-Chief.



SUMMARISED REPORT

OF THE WORK DONE IN THE

BOMBAY PLAGUE RESEARCH LABORATORY,

FOR 1896—1902.

I.

RESEARCH AND PRACTICAL WORK ON PLAGUE.

(1).—THE PLAGUE PROPHYLACTIC.

(A.)

During the first $4\frac{1}{2}$ years after the discovery of the plague inoculation, *i.e.*, up till 31st May 1901, 2,330,288 doses of prophylactic were manufactured and distributed throughout India and abroad. Of these 1,939,437 went to places in India and 440,851 to other countries.

Within India the largest consumers during that period were—

			Number of doses supplied.
The Bombay Presidency and Sind	...	...	935,139
The Punjab	...	...	571,328
The Native States	...	...	211,555
Bengal and Behar	...	...	75,332
The Madras Presidency	...	...	73,828
North-West Provinces and Oudh	...	...	32,413
The Portuguese Territory	...	...	10,703

Of the countries abroad—

214,247 doses went to Africa,
128,956 " to Australia,
55,315 " to Europe,
35,835 " to Asia outside India,
3,719 " to Australasia, and
51 " to America.

During the year following (1st June 1901 to 31st May 1902), 486,753 doses were sent out, *viz.*, 443,725 in India and 43,028 abroad. In India the largest amount was supplied to—

			Doses.
The Punjab, <i>viz.</i>	...	...	260,211
The Native States	...	...	110,695
The Bombay Presidency	...	...	48,259
The United Provinces of Agra and Oudh	...	...	9,053

Of the countries abroad—

Australia took	...	...	27,368
Asia outside India	...	...	10,923
Africa	...	...	4,523
America	...	...	204

The total of prophylactic issued from the Laboratory up to 31st May last was therefore 2,867,041 doses, of which 2,383,162 went to India and 483,879 abroad. In India, the Bombay Presidency was, on the whole, the largest consumer (983,398 doses). Then followed the Punjab (831,539 doses), Native States

(322,250), the Madras Presidency (85,461), Bengal and Behar (77,160), the United Provinces of Agra and Oudh (41,466), the Central Provinces (13,439), the Portuguese Territory (11,137), Rájputána (10,831), Burma (2,957), Assam (1,236), Central India (1,130), Berár (1,058), and the new North-Western Frontier Province (100 doses).

Outside India, Africa took 218,770 doses, Australia 156,043, Europe 55,315, Asia outside India 46,768, Australia 5,720, and America 1,263.

Subjoined are lists showing in detail—

(i) the geographical distribution of the plague prophylactic during the first four years and five months from the beginning of plague inoculation in January 1897 to the 31st May 1901; and

(ii) during the year of 1st June 1901 to 31st May 1902.

Statement showing the amount of Plague Prophylactic supplied to various places from the Research Laboratory, Bombay, between 10th January 1897 and 31st May 1901.

(Total 2,380,288 adult doses.)

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.	Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BOMBAY PRESIDENCY.			BOMBAY PRESIDENCY	
Bombay ...	10th January 1897 to 29th May 1901.	251,880		—continued.	
	<i>Ahmednagar District.</i>			<i>Dhárwár District—contd.</i>	
Ahmednagar ...	11th November 1898 to 3rd September 1900.	21,483	Gadgiri ...	10th May 1899 to 15th June 1899.	1,568
	<i>Ahmedabad District.</i>		Hubli ...	11th November 1897 to 28th November 1900.	15,406
Ahmedabad ...	31st October 1899 to 8th April 1901.	1,503	Sávnur ...	18th November 1898	1,001
Gogha ...	23rd April 1901 ...	200		<i>Kolaba District.</i>	
	<i>Aden.</i>		Alibág ...	2nd June 1897 to 9th March 1901.	
Aden ...	30th November 1899 to 4th May 1900.	25,176	Mora Uran ...	3rd May 1897 to 13th April 1901.	
	<i>Belgaum District.</i>		Pen ...	24th April 1899	
Belgaum ...	22nd December 1899 to 7th May 1901.	46,933		<i>Kárwár District.</i>	
Rámdurg...	26th November 1899 to 12th October 1899.	1,743	Kárwár ...	24th February 1898 to 12th March 1899.	
	<i>Bijápur District.</i>		Sirsi ...	6th December 1899...	
Bijápur ...	9th November 1898 to 14th August 1899.	24,950		<i>Kaira District.</i>	
Hungund ...	28th August 1898 ...	500	Anand ...	10th March 1898 to 13th February 1899.	
Ilkal ...	25th October 1898 to 12th November 1898.	3,000	Borsád ...	27th February 1899 to 7th April 1899.	
	<i>Broach District.</i>		Kaira ...	24th January 1899 to 10th October 1899.	
Anklesvar ...	26th August 1898 to 26th November 1898.	581	Umreth ...	8th November 1898 to 22nd February 1899.	
Broach ...	12th March 1897 to 3rd October 1899.	6,544	Vásad ...	7th April 1899 to 30th September 1899.	
Iláv ...	28th September 1898	1,000		<i>Khandesh District.</i>	
	<i>Dhárwár District.</i>			<i>Násik District.</i>	
Alnawar ...	8th February 1899 ...	5,082	Devláli ...	10th March 1898 to 3rd August 1900.	
Dhárwár ...	29th July 1898 to 13th November 1899.	85,347	Igatpuri ...	23th September 1897 to 21st October 1899.	
Gadag ...	3rd August 1898 to 18th December 1899.	51,461	Manmád ...	9th October 1899	
			Násik ...	22nd October 1897 to 7th March 1900.	

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.	Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
BOMBAY PRESIDENCY —continued.			BOMBAY PRESIDENCY —continued.		
<i>Poona District.</i>			<i>Thana District—contd.</i>		
Khândála ...	28th April 1897 to 10th April 1899.	742	Tarápur ...	25th March 1897 to 25th April 1897.	590
Kirkee ...	15th August 1897 to 26th September 1900.	6,384	Thána ...	14th April 1898 to 5th November 1900.	1,660
Lonávli ...	23rd March 1897 ...	560	<i>Sind Province.</i>		
Poona ...	14th March 1897 to 31st January 1901.	80,980	Hyderabad ...	30th April 1897 to 10th October 1899.	6,983
Yerrowda ...	9th October 1900 to 27th November 1900.	3,102	Karáchi ...	25th January 1897 to 23rd April 1901.	59,994
<i>Quetta District.</i>			Sukkar ...	6th May 1897 ...	50
Quetta ...	8th August 1900 ...	101	Total for Bombay Presidency ...		
<i>Panch Maháls District.</i>			9,35,139		
Godhra ...	25th February 1898 to 29th November 1898.	75	ASSAM.		
<i>Ratnágiri District.</i>			Cacher ...	21st March 1900 ...	53
Ratnágiri ...	29th January 1898 to 4th February 1898.	670	Gauhati ...	17th May 1900 ...	150
<i>Sholápur District.</i>			Shillong ...	19th May 1899 to 20th April 1900.	1,033
Sholápur ...	10th February 1897 to 24th April 1900.	12,152	Total for Assam ...		
<i>Surat District.</i>			1,236		
Bulsár ...	27th March 1897 to 25th March 1901.	2,664	BENGAL PRESIDENCY.		
Elimora ...	26th July 1898 ...	590	Bharatpur ...	10th January 1899 to 11th April 1901.	107
... ..	2nd May 1897 to 15th January 1900.	2,458	Calcutta ...	16th February 1898 to 30th March 1901.	14,014
... ..	22nd March 1901 ...	204	Chapra ...	23rd January 1901 ...	1,000
... ..	24th February 1897 to 15th November 1899.	11,413	Darjiling ...	7th May 1898 ...	100
da ...	7th January 1898 to 7th March 1899.	576	Goalpara ...	23rd May 1901 ...	51
era ...	9th February 1898 ...	513	Hazaribag ...	15th April 1901 ...	24
<i>Sátara District.</i>			Purulia ...	20th May 1898 ...	100
d ...	28th August 1897 to 6th December 1897.	1,460	Shirajgunj ...	1st May 1901 ...	6
ableshtar ...	24th February 1898 to 6th November 1900.	601	Shahabad ...	23rd February 1901 ...	1,004
hgani ...	3rd May 1897 ...	100	<i>Bihar Province.</i>		
ra ...	28th November 1897 to 14th December 1900.	8,704	Bankipur ...	26th November 1900 to 13th February 1901.	7,208
... ..	21st December 1897 ...	460	Bhagalpur ...	8th April 1901 ...	54
<i>Thana District.</i>			Durbhanga ...	6th April 1901 ...	2,513
dra ...	2nd February 1899 to 25th October 1899.	157	Dinapur ...	18th August 1900 to 16th February 1901.	202
sein ...	21st May 1897 to 27th May 1899.	202	Gaya ...	22nd February 1900 to 15th April 1901.	43,233
wndi ...	19th July 1898 ...	125	Monghyr ...	8th February 1900 to 8th February 1901.	5,515
lad ...	18th March 1899 to 21st March 1899.	2,012	Muzafarpur ...	16th March 1901 ...	201
ar ...	19th January 1899 ...	508	Total for Bengal Presidency.		
herán ...	9th February 1897 to 21st October 1899.	723	75,332		
			BURMAH.		
			Mandalay ...	9th August 1900 ...	102
			Rangoon ...	20th May 1898 to 13th October 1900.	2,819
			Total for Burma ...		
			2,921		

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.	Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
CENTRAL PROVINCE.			MADRAS PRESIDENCY —continued.		
Amraoti ...	27th February 1899 ...	103	<i>Nellore District.</i>		
Chanda ...	29th November 1898 ...	102	Nellore ...	30th August 1898 ...	50
Hinghanghat ...	22nd November 1898 to 11th January 1899.	1,562	Rayapuram ...	8th October 1898 ...	102
Jubbulpur ...	29th March 1898 to 9th August 1900.	302	<i>South Canara District.</i>		
Khândwa ...	13th April 1898 ...	100	South Canara ...	10th September 1898 ...	25
Kampti ...	9th February 1900 to 11th August 1900.	56	<i>Salem District.</i>		
Nágpur ...	10th March 1898 to 9th January 1901.	8,801	Ootacamand ...	26th August 1898 to 31st October 1898.	1,064
Ráipur ...	11th May 1898 to 1st December 1898.	74	Tirrupatur ...	3rd August 1898 ...	90
Sangor ...	17th August 1900 to 20th August 1900.	92	<i>South Coorg.</i>		
Wardha ...	10th December 1898 to 20th August 1900.	1,104	Sidapur ...	2nd September 1899 to 16th November 1900.	755
Yeotmahal ...	1st December 1898 ...	30	<i>Tinnevelly District.</i>		
Total for Central Provinces.		12,326	Birur ...	26th October 1898 ...	200
CENTRAL INDIA.			Kadar ...	26th October 1898 ...	100
Neemuch...	14th August 1900 ...	100	Palamkotta ...	27th October 1898 ...	300
Nowgong...	15th August 1900 ...	20	Shrivillyputur ...	6th October 1898 ...	150
Total for Central India		120	Tinnevelly ...	8th October 1898 to 31st October 1898.	1,200
FRONTIER DISTRICT.			Tuticoria...	28th September 1898 to 17th November 1898.	1,500
Malakand ...	8th April 1900 ...	100	<i>Tellicherry District.</i>		
MADRAS PRESIDENCY.			Tellicherry ...	1st November 1898 to 18th November 1898.	88
Madras ...	10th October 1897 to 19th March 1901.	63,268	Total for Madras Presidency.		
<i>Coimbatore District.</i>			THE PUNJAB.		
Coimbatore ...	2nd September 1898 to 9th November 1898.	626	Attock ...	21st August 1900 ...	20
<i>Ooonur District.</i>			Abbottabad ...	13th August 1900 ...	
Coonur ...	28th September 1898 to 12th October 1898.	1,452	Almora ...	16th August 1900 ...	
<i>Chickmaglore District.</i>			Amritsar ...	11th April 1899 ...	
Chickmaglore ...	4th February 1899 ...	100	Banga ...	14th March 1898 to 26th March 1901.	
Cananoor ...	17th October 1899 to 11th November 1899.	2,024	Chitral ...	21st May 1898 ...	
Devangiri ...	8th September 1899 to 18th September 1899.	4,030	Cambellpore ...	17th August 1900 ...	
<i>Canara District.</i>			Delhi ...	9th May 1898 to 16th April 1901.	
Haliyál ...	29th September 1900 to 26th October 1900.	1,361	Dehra Ismailkhan.	9th August 1900 ...	
<i>Koppa District.</i>			Dalhousie ...	14th August 1900 ...	
Koppa ...	5th October 1898 ...	50	Edwardesabad ...	9th August 1900 ...	29
Mercarra ...	18th November 1898 to 5th May 1900.	973	Ferozepore ...	10th May 1901 ...	
			Garhshanker ...	18th April 1899 ...	
			Gurdaspur ...	26th March 1901 to 22nd April 1901.	
			Jullundur ...	31st March 1900 to 4th April 1901.	
			Lansdown Cantonment.	9th August 1900 ...	
			Ludhiana ...	30th May 1901 ...	
			Lahore ...	28th February 1898 ...	
			Murree ...	20th July 1899 ...	
			Navashahr ...	17th May 1899 to 21st December 1900.	
			Peshawar ...	13th August 1900 ...	2
			Phagwara ...	23rd October 1897 ...	

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.	Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
PUNJAB—continued.			UNITED PROVINCES OF AGRA AND OUDH—contd.		
Rawalpindi ...	6th August 1900 ...	1,002	Roorkee ...	26th September 1899 to 5th August 1900.	550
Simla ...	25th May 1898 to 25th April 1901.	2,956	Sitapur ...	2nd February 1900 to 13th August 1900.	284
Sialkot ...	21st August 1900 to 11th March 1901.	10,224	Shahajahanpur ...	9th October 1899 ...	504
Umballa ...	13th August 1900 to 2nd May 1901.	136	Shaharanpur ...	25th September 1899 ...	501
Total for the Punjab ...		5,71,328	Total for United Provinces of Agra and Oudh ...		32,413
RAJPUTANA.			NATIVE STATES.		
Abu Road ...	9th June 1898 to 25th November 1898.	307	Baroda State.		
Falna ...	29th March 1901 to 11th April 1901.	6,015	Baroda ...	13th November 1897 to 29th April 1899.	14,587
Total for Rajputana ...		6,322	Bhor State.		
UNITED PROVINCES OF AGRA AND OUDH.			Bhor ...	19th November 1898 ...	48
Agra ...	16th October 1899 to 17th April 1901.	3,373	Bundelkhand Agency.		
Aligarh ...	27th September 1899 ...	506	Bhagalkhand ...	27th September 1899 to 6th May 1901.	200
Allahabad ...	25th August 1899 to 17th April 1901.	8,494	Indore ...	13th July 1899 to 11th March 1901.	124
Azamgarh ...	28th September 1899 to 20th April 1901.	514	Dutch-Bhuj Agency.		
Ballia ...	27th October 1899 to 28th October 1899.	1,000	Bhuj ...	19th April 1897 to 26th March 1900.	2,207
Badaun ...	20th October 1899 ...	507	Kolhapur Agency.		
Bareilly ...	9th October 1899 to 9th August 1900.	600	Kolhapur ...	6th July 1898 to 10th October 1899.	1,103
Bulandshahar ...	5th October 1899 ...	500	Miraj ...	16th February 1898 to 10th October 1899.	5,774
...	28th September 1899 to 9th March 1901.	3,590	Sangli ...	16th March 1898 to 2nd October 1899.	926
...	27th September 1899 ...	506	Shapur ...	10th March 1898 to 5th October 1899.	3,259
...	13th August 1900 ...	100	Kathiawar Agency.		
...	9th October 1899 to 4th August 1900.	704	Bhavnagar ...	5th April 1900 to 8th November 1900.	320
...	13th August 1900 ...	500	Jamnagar ...	13th September 1898 to 25th November 1898.	1,472
...	27th September 1899 ...	507	Junagad ...	28th June 1897 to 2nd October 1899.	2,919
...	16th August 1900 ...	500	Porbandar ...	26th August 1898 to 7th March 1900.	773
...	21st October 1899 ...	514	Rajkot ...	25th February 1898 to 21st September 1898.	432
...	25th November 1899 ...	500	Kashmir.		
...	9th October 1899 to 10th August 1900.	530	Jammu ...	3rd December 1900 to 12th December 1900.	5,417
...	27th September 1899 to 17th April 1901.	1,038	Kashmir ...	3rd April 1901 ...	1,206
...	27th September 1899 to 17th April 1901.	507	Mahi Kantha Agency.		
...	13th October 1897 ...	63	Sadra ...	5th May 1899 ...	25
...	28th September 1899 ...	507			
...	9th October 1899 ...	512			
...	15th March 1897 to 4th August 1900.	1,210			
...	11th October 1899 ...	501			
...	10th October 1899 ...	501			
...	28th September 1899 to 9th May 1901.	753			
...	28th September 1899 to 9th May 1901.	502			
...	27th September 1899 ...	504			
...	6th August 1900 to 17th April 1901.	122			
...	9th January 1900 ...	507			
...	10th August 1900 ...	52			

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.	Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
NATIVE STATES— <i>contd.</i>			COUNTRIES OUTSIDE INDIA, ASIA— <i>continued.</i>		
<i>Mysore State.</i>			<i>Ceylon.</i>		
Bangalore ..	24th March 1897 to 5th November 1900.	1,16,764	Colombo ...	23rd April 1897 to 3rd May 1901.	14,031
Mysore ...	17th September 1898 to 2nd November 1899.	19,486	Galle ...	15th May 1899 ...	200
Kistna ...	5th October 1898 ...	200	<i>China.</i>		
Ourgaum...	17th October 1898 to 17th July 1899.	10,421	Hongkong ...	27th April 1898 to 28th April 1899.	2,806
<i>Nizám's Dominions.</i>			Shanghai ...	22nd May 1901 ...	1,001
Aurangabad ...	5th November 1900 to 30th November 1900.	502	<i>Cyprus Island.</i>		
Hyderabad ...	11th August 1898 to 13th July 1899.	17,375	Cyprus ...	17th November 1900 to 18th January 1901.	216
Kopbal ...	11th May 1899 ...	1,133	Nicosia ...	8th June 1899 ...	50
Secunderabad ...	18th April 1899 to 28th January 1901.	500	<i>Seychelles Island.</i>		
Lingsagar (Rai-chur District).	24th January 1899 ...	101	Seychelles...	12th April 1899 to 22nd May 1901.	1,004
<i>Pálanpur Superintendency.</i>			<i>Straits Settlements.</i>		
Deesa ...	16th August 1900 ...	100	Negri Sembilan ...	6th February 1900...	501
Pálanpur ...	15th October 1897 ...	36	Singapore ...	9th March 1901 ...	592
<i>Eastern Rájputána States.</i>			OTHER COUNTRIES IN ASIA.		
Bharatpur ...	15th April 1897 ...	20	<i>Japan.</i>		
<i>Western Rájputána States.</i>			Delivered to the Japanese Consul for Japan in Bombay.	25th January 1900 ...	2,304
Jodhpur...	4th January 1900 to 25th March 1901.	1,560	<i>Phillipine Islands.</i>		
<i>Sávantvádi States.</i>			Manilla ...	20th January 1900 ...	
Sávantvádi ...	21st October 1898 to 7th October 1899.	71	<i>Asiatic Russia.</i>		
<i>Travancore State.</i>			Port Arthur ...	11th September 1899 to 30th November 1899.	
Cochin ...	27th October 1898 ...	40	Samarkand ...	1st November 1898 ...	
Travancore ...	29th October 1898 to 14th December 1898 ...	2,454	<i>Turkey in Asia.</i>		
Total for Native States ...			Smyrna ...	29th June 1900 ...	
FOREIGN TERRITORY IN INDIA.			Total for Countries in Asia outside of India ...		
<i>Portuguese Territory.</i>			EUROPE.		
Damann ...	10th June 1897 to 16th April 1901.	10,137	<i>England and Great Britain's Possessions.</i>		
Goa ...	2nd February 1898 ...	1,000	London ...	9th April 1897 to 4th November 1899.	
Total for Foreign Territories in India ...			<i>Malta.</i>		
11,137			Malta ...	22nd September 1899 ...	
COUNTRIES OUTSIDE INDIA, ASIA.					
<i>British Dominions.</i>					
<i>Arabia.</i>					
Muscat ...	7th May 1900 to 2nd May 1900.	1,010			

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.	Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
EUROPE— <i>continued.</i>			AMERICA.		
OTHER COUNTRIES IN EUROPE.			WEST INDIES.		
HOLLAND.			BRITISH POSSESSIONS.		
<i>The Hague.</i>			<i>Barbadoes.</i>		
The Hague ...	10th February 1900... ..	12	Barbadoes ...	3rd January 1900	51
RUSSIA.			<i>Grenade.</i>		
<i>St. Petersburg.</i>			Grenada		
St. Petersburg ...	26th September 1899	108	12th September 1900		
Total for Europe ...			Total for America ...		
55,315			1,059		
AFRICA.			AUSTRALASIA.		
BRITISH POSSESSIONS.			BRITISH POSSESSIONS.		
<i>East Africa.</i>			Auckland (New Zealand). (New Zealand).		
Mombasa ...	17th February 1898 to 18th January 1900.	6,096	20th January 1900 to 18th March 1901.	4,109	
Mauritius ...	16th February 1899 to 23rd February 1900.	110,621	Tasmania ...	14th March 1900 to 10th April 1900.	1,311
Zanzibar ...	21st February 1899	5,059	Wellington ...	2nd May 1900	300
FRENCH EAST AFRICA.			Total for Australasia ...		
Madagascar ...	27th January 1899	200	5,720		
GERMAN POSSESSION.			AUSTRALIA.		
Dar-es-Salam ...	25th April 1901	503	Adelaide ...		
PORTUGUESE EAST AFRICA.			Brisbane ...		
<i>Mozambique.</i>			Fiji Island ...		
Mozambique ...	4th September 1899	1,008	26th January 1900 to 20th April 1900.		
BRITISH POSSESSIONS.			Melbourne ...		
<i>South Africa.</i>			12th January 1900 to 25th May 1900.		
Town ...	14th February 1899 to 14th March 1901.	20,762	New Caledonia ...		
... ..	13th March 1899 to 20th February 1900.	51,294	2nd May, 1900		
Maritzburg ...	18th January 1899	102	Perth ...		
<i>Transvaal.</i>			9th February 1900 to 23rd March 1901.		
nesburg ...	19th January 1899 to 20th February 1899.	18,100	Queensland ...		
Total for Africa ...			21st April 1900		
213,745			Sydney ...		
			6th November 1899 to 15th May 1900.		
			Total for Australia ...		
			1,28,675		
			Grand Total ...		
			2,380,288		

Statement showing the amount of Plague Prophylactic supplied to various places from the Research Laboratory, Bombay, between 1st June 1901 and 31st May 1902.

(Total 486,753 adult doses.)

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.	Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
	BOMBAY PRESIDENCY.			BOMBAY PRESIDENCY —continued.	
Bombay ...	3rd June 1901 to 22nd May 1902.	4,298		Panch Mahals.	
	Ahmednagar District.		Godhra ...	22nd March 1902 ...	209
Ahmednagar ...	7th October 1901 to 7th December 1901.	3,005		Sholapur District.	
	Ahmedabad District.		Sholapur ...	2nd December 1901 to 2nd January 1902.	600
Ahmedabad ...	24th October 1901 to 12th March 1902.	1,072		Surat District.	
	Aden.		Bulsar ...	18th October 1901 to 5th November 1901.	36
Aden ...	17th May 1902 ...	2,005	Khergam...	19th October 1901 ...	276
	Belgaum District.		Navsari ...	8th October 1901 ...	200
Belgaum ...	19th July 1901 to 3rd May 1902.	3,217	Surat ...	16th December 1901 ...	52
	Bijapur District.		Udvada ...	26th April 1902 ...	54
Bijapur ...	23rd May 1902 ...	204		Satara District.	
	Broach District.		Satara ...	13th November 1901 to 10th December 1901.	402
Anklesvar ...	18th September 1901 ...	100		Thana District.	
Broach ...	27th August 1901 to 28th October 1901.	1,532	Matheran...	31st October 1901 ...	102
	Dharwar District.		Thana ...	15th March 1902 to 26th 1902.	268
Dharwar ...	18th November 1901 to 14th May 1902.	2,317		Sind Province.	
Gadag ...	26th September 1901 to 13th November 1901.	1,506	Hyderabad ...	23rd July 1901 ...	502
Hubli ...	25th June 1901 to 21st October 1901.	5,514	Karachi ...	8th August 1901 ...	2,008
	Kolaba District.			Total for Bombay Presidency and Sind,	48,259
Alibag ...	31st January 1902 ...	48		BENGAL PRESIDENCY.	
	Kaira District.		Bharatpur ...	10th April 1902 ...	12
Anand ...	11th and 26th February 1902.	1,008	Calcutta ...	6th February 1902 ...	350
Nadiad ...	17th October 1901 ...	1,001	Chupra ...	21st October 1901 to 8th April 1902.	
	Khândesh District.		Ghaziipur...	8th April 1902 ...	
Dhulia ...	1st February 1902 ...	501	Hazaribagh ...	11th November 1901 ...	
	Nasik District.			Bihar Province.	
Nasik ...	12th December 1901 ...	503	Bhagalpur ...	19th October 1901 ...	
	Poona District.			Total for Bengal Presidency and Bihar.	
Kirkee ...	18th December 1901 ...	1,001		BERAR PROVINCE.	
Poona ...	7th June 1901 to 2nd December 1901.	11,725	Akola ...	8th March 1902 ...	
Yerrowda ...	8th October 1901 ...	2,002	Wun ...	1st March 1902 ...	
			Mulapur ...	4th March 1902 ...	
				Total for Berar Province ...	

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.	Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
BURMA.			THE PUNJAB—continued.		
Hangoon ...	20th January 1902 ...	36	Sháhápúr ...	27th February 1902 to 26th April 1902.	530
CENTRAL PROVINCES.			Simla ...	3rd March 1902 ...	500
Burhánpur ...	17th December 1901 ...	106	Sabathu ...	26th May 1902 ...	54
Saugor ...	8th April 1902 to 24th April 1902.	1,007	Umbálla ...	13th December 1901 to 20th May 1902.	66,579
Total for Central Provinces.			Total for the Punjab ...		
		1,113			260,211
CENTRAL INDIA.			. RAJPUTANA.		
Nowgong...	28th February 1902 ...	1,010	Ajmere ...	20th March 1902 ...	1,003
MADRAS PRESIDENCY.			Somesar ...	29th March 1902 ...	2,006
Madras ...	11th July 1901 ...	5,151	Ulwár ...	10th March 1902 ...	1,500
Canara District.			Total for Rájputána ...		
Háliyal ...	8th October 1901 ...	200			4,509
Mangalore ...	9th May 1902 ...	502	UNITED PROVINCES OF AGRA AND OUDH.		
Madura District.			Agra ...	24th June 1901 to 18th April 1902.	577
Madura ...	2nd December 1901 ...	100	Aligarh ...	22nd June 1901 ...	501
Total for Madras Presidency.			Allahabad ...	7th January 1901 to 25th March 1902.	1,711
		5,953	Benáres ...	9th October 1901 to 18th March 1902.	532
THE PUNJAB.			Bulandsháhr ...	10th June 1901 ...	502
Amritsar ...	3rd March 1902 to 1st May 1902.	4,144	Balia ...	21st September 1901 ...	36
Bikáneer ...	14th March 1902 ...	1,005	Bareilly ...	24th October 1901 ...	120
Dehra-Ismail Khan ...	4th February 1902 ...	990	Básti ...	3rd June 1901 ...	20
Dehra Basi ...	29th and 30th April 1902 ...	1,007	Chaubattia ...	18th October 1901 ...	150
... bad ...	26th February 1902... ..	504	Cáwnpore ...	10th February 1902 to 26th April 1902.	655
... e ...	20th June 1901 ...	12	Dehra-Dun ...	1st March 1902 ...	128
... e ...	5th April 1902 ...	1,003	Dhuri ...	21st April 1902 ...	48
... e ...	5th February 1902 to 29th March 1902.	26,250	Fatehgarh ...	10th June 1901 ...	502
... ..	28th December 1901 to 30th April 1902.	2,204	Fyzábád ...	27th June 1901 ...	504
... la ...	18th March 1902 to 20th May 1902.	1,209	Fatíhpur... ..	10th February 1902... ..	503
... r ...	24th December 1901 to 1st May 1902.	34,130	Gorákhpur ...	16th January 1902 ...	100
... ..	27th February 1902 to 13th March 1902.	10,662	Lucknow... ..	10th June 1901 to 23rd May 1902.	126
... ..	18th February 1902... ..	204	Morádabad ...	3rd June 1901 to 15th April 1902.	512
... ..	19th February 1902... ..	1,007	Muttra ...	1st August 1901 ...	24
... ..	1st March 1902 ...	247	Mirzápur... ..	27th January 1901 ...	600
... ..	6th March 1902 ...	100	Mussooree ...	4th April 1902 ...	502
... ..	1st March 1901 to 23rd ...	17,076	Pratábgarh ...	30th December 1901 ...	48
... ..	... 1902 to 21st ...	43,713	Roorki ...	10th June 1901 ...	502
... ..	2nd ... 02 ...	1,006	Sháhájáhanpur ...	10th March 1902 ...	50
... ..	28th November 1901 to 3rd May 1902.	559	Sháháranpur ...	14th March 1902 ...	100
... ..	3rd February 1902 ...	752	Total for the United Provinces.		
... ..	5th April 1902 to 12th May 1902.	8,546			9,053
... ..	6th May 1902 ...	16	NATIVE STATES.		
... ..	14th April 1902 to 12th May 1902.	8,023	Baroda State.		
... ..	29th March 1902 ...	5,028	Baroda ...	25th March 1902 to 4th April 1902.	607
... di ...	18th March 1902 ...	100	Bundelkund Agency.		
... ..	11th December 1901 to 24th December 1901.	23,051	Indore ...	30th April 1902 ...	6
			Jeypore State.		
			Jeypore ...	4th March 1902 ...	100

Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.	Name of Town or Village.	Name of Presidency and District and date of despatch.	Number of Doses.
NATIVE STATES—contd.					
<i>Jhind State.</i>			<i>Ceylon.</i>		
Jhind ...	17th May 1902 ...	504	Colombo ...	7th June 1901 to 10th January 1902.	4,014
<i>Káthiáwár Agency.</i>			<i>China.</i>		
Bhávnagar ...	8th October 1901 ...	108	Amoy ...	6th June 1901 ...	1,008
Nayánagar ...	14th April 1902 ...	402	Chefoo ...	5th September 1901...	1,002
Rájkot ...	21st April 1902 to 30th April 1902.	1,004	Foochow ...	4th November 1901...	504
<i>Kapurthála State.</i>			Hongkong ...	17th December 1901 ...	4,011
Kapurthála ...	29th March 1902 ...	1,007	<i>Straits Settlements.</i>		
<i>Kashmir.</i>			Selángore ...	6th June 1901 ...	153
Jammu ...	22nd December 1901 to 31st January 1902.	15,039	Singapore ...	15th June 1901 ...	216
<i>Kolhápur Agency.</i>			Total for Asia outside India.		10,933
Kolhápur ...	8th October 1901 ...	232	AFRICA.		
Miraj ...	30th August 1901 to 26th November 1901.	305	<i>BRITISH DOMINIONS.</i>		
<i>Mysore State.</i>			<i>British East Africa.</i>		
Bangalore ...	9th August 1901 to 14th December 1901.	2,805	Mombassa ...	26th May 1902 ...	2,010
<i>Nizam's Dominions.</i>			Zanzibár ...	11th July 1901 to 14th March 1902.	2,009
Aurangabad ...	4th November 1901...	174	<i>GERMAN EAST AFRICA.</i>		
Secunderabad ...	3rd December 1901 ...	502	Tanga ...	13th August 1901 ...	504
<i>Nabha State.</i>			Total for Africa ...		
Nabha ...	19th December 1901 to 28th April 1902.	17,043	AMERICA.		
<i>Patiála State.</i>			<i>BRITISH POSSESSIONS.</i>		
Patiála ...	18th February 1902 to 23rd May 1902.	70,857	<i>West Indies.</i>		
Total for Native States ...		1,10,695	Trinidad ...	3rd June 1901 to 11th July 1901.	
Total for India ...		4,43,725	AUSTRALIA.		
COUNTRIES OUTSIDE INDIA.			Adelaide ...	13th June 1901 to 10th March 1902.	
ASIA.			Sydney ...	10th March 1902 to 25th April 1902.	
<i>BRITISH DOMINIONS.</i>			Total for Australia ...		
<i>Andaman Islands.</i>			Total for Countries outside India.		
Port Blair ...	20th June 1901 ...	30	Grand Total ...		

(B.)

The activity of the Plague Research Laboratory has been from the beginning of the outbreak in Bombay, concentrated on the preparation of a fluid protective against plague, and I think it important to explain the reason for this to Government and to the Medical authorities. I may quote in this connection my letters to the Secretary to the Government of India in the Home Department, dated Hardwar, 20th November 1897, and Bombay, 21st June 1898, as well as my addresses of the 3rd January 1898, in the Poona Cantonment Magistrate's Office, under the Presidentship of Major-General Duncan (*"Times of India"* Press, Bombay), and of the 8th June 1899, at the Royal Society, London (Proceedings, Vol. LXV).

The studies made for working out a protective treatment against plague comprise preliminary experiments in the Laboratory, the details of which cannot, unfortunately, be published so far, and a long and difficult series of investigations in communities affected with plague.

The discovery of the protective vaccine was reported to the Secretary to the Government of India, in the Home Department, in this office letters dated 16th January, 15th February and 14th July 1897 (*vide* Mr. Nathan's "The Plague in India in 1896-1897," Vol. II, pages 32-39), and published in the "*British Medical Journal*," May 1897; the "*Indian Medical Gazette*," June of same year; the Proceedings of the Royal Society, London, 1899, Vol. LXV; and in the "Minutes of Evidence taken by the Indian Plague Commission," Vol. I, Calcutta, 1900, pages 4 *et seq.*

Since my first publications the following are the alterations introduced in the method of manufacturing the prophylactic.

Lieut.-Colonel C. J. H. Warden, I. M. S., started the manufacture, in the Laboratory, of peptone from goat's meat, so as to avoid the necessity of buying the material in Europe. The result of his work was reported to the Secretary to the Government of India, Home Department, in this office letter No. 260A of 7th June 1898.

Dr. Charles Balfour Stewart's experiments made in the Laboratory on the effect of different degrees of alkalinity upon the growth of the plague bacillus, and on its cultivation in peptonised cheese and in certain other albuminous substances were referred to in that officer's evidence to the Indian Plague Commission, Vol. III, page 16 of their Report. The experiments of Dr. A. Mayr, at the time serving in this Laboratory, on the effect of the addition of gelatine, glycerine, sugar, with varying degrees of alkalinity, were mentioned in his evidence to the same Commission, Vol. III, page 18; those by Dr. E. L. Marsh, on the effect of nitrogen and carbonic acid gas, in his evidence, Indian Plague Commission's Report, Vol. III, pages 72 and 73; and lastly, the experiments by Dr. F. M. Gibson, on the preparation of a peptonised medium from wheat flour, were reported to Government in this office Nos. 6092 of 29th November, and 6216 of 15th December 1899, to the address of the Chief Secretary to the Government of Bombay (*vide* also *Bombay Government Gazette*, December 14th, 1899, page 1857).

In 1899 Dr. Charles Balfour Stewart and Captain Milne, I. M. S., made a series of experiments in the Laboratory in order to verify the existence of immunising properties in the fluid and solid parts of the prophylactic. The former subsequently published his observations in the "*British Medical Journal*," 1899.

The following technical modifications have not yet been put on record:

The method of peptonising meat employed by Lieut.-Colonel Warden consisted in heating a mixture of goats' meat with hydrochloric acid for 6 hours, at a T of 144° C., the proportion used being 150 c.c. of acid to a kilo of meat.

At the end of the process, the acid, which would otherwise be antagonistic to the culture, has to be neutralised. 150 c.c. of hydrochloric acid, acted upon,

for this purpose, with caustic soda, gets transformed into some 80 grammes of common salt. This must now be largely diluted, as the amount of salt compatible with the growth of microbes does not exceed, as a rule, $\frac{1}{2}$ per cent. to $\frac{2}{4}$ per cent. of the solution. The nourishing elements obtained from the kilo. of meat and containing the 80 grammes of salt must therefore be mixed with water up to 12 to 16 litres, in order to reduce the proportion of salt to the desired amount. The salt is thus sufficiently diluted, but the nourishing elements of the liquid are much diluted also.

If the amount of acid be reduced, so as to avoid the formation of large quantities of salt, the meat will be digested only if that reduction in acid is compensated by an increase in heating. At temperatures above 144° C., however, and even at that temperature, meat, like other organic matter, begins to decompose, gets charred, and communicates to the fluid a dark brown colour, due to various decomposition products such as tar, naphtha, creosote, carbolic acid, and kindred substances, which act as antiseptics and inhibit microbial growth.

To obviate these difficulties, Dr. Gibson has introduced the plan of reducing the amount of acid and increasing the heating in *length* instead of in *degree*. At present a kilo. of meat is treated in this Laboratory with 80 c. c. of hydrochloric acid, instead of 150, and kept for six days at 80° C. and three hours at 114° C., instead of six hours at 144° C. The reduction of the amount of acid permits, as explained above, of subsequently diluting the produce of 1 kilo. of meat by some 6 litres of water only, and gives a cultivation medium twice as concentrated as that used before.

For cultivating the prophylactic, flasks are filled with broth to a lower level than before, so as to provide a more abundant aeration of the fluid. This plan, very beneficial in itself, involves an increase in the number of flasks, and consequently in the labour required for inseminating, testing and sterilising, which are applied to each flask individually. The flasks are inseminated with a much larger amount of microbes than before, in order to accelerate the maturing of the culture. The cultivation flasks are only slightly vibrated for the periodical dislocation of surface growth, instead of being shaken up. The cultures, when mature, are sterilised by heating for 15 minutes only, at 50° to 55° C., instead of an hour at 65° C. An additional test for effective sterilisation is applied. In determining the thickness of growth, Dr. Gibson takes account of the light in which examination is made, as he found that the liquid appears more opaque in a well lighted, than in a darkened room.

An important alteration is now being tried in the method of preparing the prophylactic, in accordance with the ideas explained in this office letter to the Home Secretary, No. 260A. of 7th June 1898, and which consists in combining, for the formation of the prophylactic, agar and broth cultivations. A four days growth on 300 sq. centimetres of agar surface is emulsified in 400 c.c. of a two months old broth cultivation. The addition of a young growth of microbes may further reduce the case incidence of the disease in those inoculated.

The prophylactic is now decanted into special laboratory phials made for the purpose, instead of in medicine bottles. These phials have their necks at one corner instead of in the middle. The whole of their contents can, without pouring the latter out into an open vessel, be absorbed into a hypodermic syringe. The packing of the bottles with economy in space and in a safe way, the rubber stoppers serving as buffers, is also facilitated. India-rubber stoppers have now been substituted for ordinary corks, which could not be sterilised with certainty.

A number of patterns of inoculation syringes were tested in the Laboratory and distributed to workers, whose experience was recorded. The pattern to which preference has been given is the 20 c.c. syringe perfected by Roux and manufactured by Collin-Charrière in Paris. After several attempts, an excellent article has been evolved by Mr. Eyres, of the Government Medical Stores, Bombay. Unfortunately the workshops of the latter have provision for only a limited outturn.

During the period of $5\frac{5}{12}$ years under record 1,733 hypodermic syringes of the approved patterns were distributed by the Laboratory to operators intending

to take up inoculation; of the above number 929 were sold and 854 given on loan (*vide* Government of Bombay Resolution, General Department, Plague, No. ⁵⁷⁷⁸₆₈₇₀-P. of 17th October 1898). According to the two periods here adopted, the figures were:

During the $4\frac{5}{12}$ years, from January 1897 to 31st May 1901. { 697 syringes sold, and
775 „ lent.

Total ... 1,472

During the year 1st June 1901 to 31st May 1902. { 232 syringes sold, and
79 „ lent.

Total ... 311

In the *technique* of the inoculation operation, an improvement has been effected in accordance with Government of Bombay Resolutions No. 2230-P. of 4th April 1900, and No. 3836-P. of 21st June 1900, by the designing of a special lamp and oil boiler for sterilising hypodermic syringes and needles. Government Resolution No. 3109-P. of 23rd July 1901 directs the lamp to be designated as Hunt's sterilisation lamp, after the name of the officer of the Laboratory who carried out the work.

(C.)

The general effect of the prophylactic on man, as distinct from its *specific* immunising properties, has been studied in two ways, *viz.*:

(1) by observing the reaction following inoculation in a few hours. The significance of these observations was explained, amongst others, in the "Evidence" to the Plague Commission, Volume I, pages 10, 11 and 17, and Volume III, pages 349—351, of their Report, and in this office Report to the Government of Bombay, General Department, Plague, No. 1269 of 9th August 1900, pages 2—18, as well as in my address referred to below "On the health of the inoculated." Tens of thousands of such observations have been made, and their results taken into account in varying the preparation of the prophylactic and determining the doses prescribed. The assistances of a number of medical officers having special opportunities for such observations is gratefully acknowledged here.

And (2), by tracing the subsequent history of the inoculated. This was done on an extensive scale among the Khojas of Bombay; in the general population of Dhárwār, Hubli and Gadág; in the Poona Cantonment; among the Parsis of Bombay; in the Nágpur and Thána Jails; in Undhera (Baroda taluka); and elsewhere. The result of the enquiry among the Khojas for the year 1897-98 has been published in this office report to Government, dated 10th May 1898. The enquiry for the year subsequent (1898-99) was made in a much more complete fashion, by the late Surgeon-General Harvey, I. M. S., Major Bannerman, I. M. S., Dr. F. M. Gibson, Captain Charles Robertson Milne, I. M. S., Dr. Marsh and myself, and gave results in every way analogous to those of the first year. The result of the Poona enquiry has been recorded in a report by Lieutenant-General C. J. Burnett, C.B., then Commanding the Forces, Madras, of 11th June 1901, to the Government of Bombay (published according to Government Resolution No. 600-P. of 17th February 1902). The Parsi enquiry, probably the most elaborate and complete ever done, is being concluded now, and the results will be reported to Government.

The above enquiries were summarised in an address delivered by me in Poona under the chairmanship of His Excellency the Governor on the 29th June 1901. ("Times of India" Press, Bombay 1901).

Very accurate observations on the matter are also being carried out in the Thána Special Prison, and will be reported upon subsequently.

(D.)

The methods of finding out the immunising properties of a vaccine on man are not nearly so simple as might appear at first sight; the reason being that the crucial test of submitting the immunised subject to a dose of lethal virus is inadmissible in his case. The methods in question were worked out by me, first, in connection with anti-cholera inoculation in Bengal and Upper India, 1893-94 (*vide* "Anti-cholera Inoculation in India," *Transactions of the first Indian Medical Congress, Calcutta, 1894*, and "*Indian Medical Gazette*," January and February 1895), and further developed in my studies on anti-plague inoculation in Lonávla and Kirkee in 1897-98. The information given in 1898-99 to the Indian Plague Commission (*vide* Volume 1 of their Report, page 7 *et seq.*) had been collected in accordance with these methods. (The methods were discussed by them in Volume V of their Report, pages 203—205). The matter was further analysed in my notes on the investigations of the Dhárwár Committee and those in the Poona Cantonment, and reported to Government in this office letters Nos. 363 of 8th March 1901, and 2095 of 4th and 5th November 1901 (*vide* "Appendices" to the Report of the Dhárwár Inoculation Investigation Committee and to that of General Burnett quoted above, Government Central Press, Bombay). A variety of questions connected with these studies has further been considered by the Parsi Inoculation Investigation Committee.

In accordance with the principles laid down in the above publications, officers of the Laboratory studied the protective effect of anti-plague inoculation in the following outbreaks: in the Byculla House of Correction; in the Bombay general population; in Uran, Mora Municipality, Bombay Harbour; in Damaun; Lonávla; Kirkee; the Belgaum Cantonment; in the Umarkhádi Common Jail, Bombay; in Undhera, Baroda Taluka; in the Khoja and Parsi communities of Bombay; in Colaba, in Káráchi, among the Khojas (by Dr. Gibson); and in the Poona Cantonment.

The most extensive studies by officers not belonging to the Laboratory were carried out in Hubli, Dhárwár, Gadág, Ahmednagar, Mauritius, Bulsár, Aden, in the Punjáb villages, and elsewhere.

Most of the above investigations were embodied in the following reports and publications:—

Report dated Bombay, 16th February 1897, to the Secretary to the Government of India, Home Department, on the anti-plague protective inoculation in the Byculla House of Correction.

Report of 14th July 1897, to the same authority, on anti-plague inoculation in the Bombay general population.

"On the epidemic of plague in Lower Damaon and on the effect of preventive inoculation there", joint Report to Government by Mr. W. M. Haffkine and Major Lyons, I. M. S., dated Bombay, 1st November 1897, "*Times of India Press*", forwarded to the Secretary to the Government of India, Home Department, with letter dated Hardwar, 19th November 1897.

"Protective inoculation against plague", public address delivered under the presidency of Major-General Duncan, in the Cantonment Magistrate's Office, Poona, 3rd January 1898 (Bombay, "*Times of India Press*."

"Experiment on the effect of protective inoculation in the epidemic of plague at Undhera, taluka Baroda, February and March 1898." Report dated 10th April 1898, Bombay (*locus cit.*)

"Report on the preventive inoculations against plague in the Khoja community of Bombay during the epidemic of 1897-98," Bombay, 10th May 1898 (Government Central Press, Bombay).

Report No. 1269 of 9th August 1900, to Government, on the manufacture of plague prophylactic in the Plague Research Laboratory, Bombay, containing an account of an investigation in Colaba (Government Central Press, Bombay).

Amongst the Reports published on the subject by officers not belonging to the Laboratory may be mentioned :

“Report on plague and inoculation in Hubli”, by E. L. Cappel and Surgeon-Captain B. M. F. Leumann, I. M. S., 19th October 1899 (Government Central Press, Bombay).

“Report on Anti-plague Inoculation work in the Dhárwár District”, by Miss Alice Corthorn, M.B., B.S., June 1899 (Government Central Press, Bombay).

“Statistics relating to inoculation round about Nagar. Report to the Collector, Ahmednagar”, by F. G. H. Anderson, Esquire, I. C. S., dated Nagar, 22nd October 1899 (Government Central Press, Bombay).

“Ahmednagar Inoculation Statistics, by C. Hudson, Esquire, I. C. S., 24th July 1900” (Government Central Press, Bombay).

“Inoculation and Plague Operations in Ahmednagar and district during the epidemic of 1899”, by Major C. J. Sarkies, I. M. S., 27th June 1900 (Government Central Press, Bombay).

“Report of the Dhárwár Inoculation Investigation Committee”, June 1900.

“Extract of Report on the effects of Inoculation among the Jewish community at Aden with Haffkine's anti-plague vaccine”, by Assistant Surgeon S. M. Mehta, published by the General Department, Bombay Government, 9th March 1901 (Government Central Press, Bombay).

“Report on the Plague Operations carried out in Poona Cantonment for the half-year ending 31st December 1900”, by Lieutenant-General C. J. Burnett, Commanding the Forces, Madras (Government Central Press, Bombay).

“Anti-plague Inoculation among the Parsis of Bombay”, by the Parsi Inoculation Investigation Committee, March 1902.

A certain amount of other information on the matter was communicated to the Indian Plague Commission by various officers in India in 1898 and 1899 (*vide* their Report, *passim*.)

An enquiry may also be mentioned which was made with reference to the Secretary of State's telegram to the Governor of Bombay, dated 2nd February 1897, on the possible protection against plague to be derived from small-pox vaccination. The order was conveyed to the Laboratory by the Municipal Commissioner of Bombay, with his memorandum No. 23345 of 4th February 1897, and a report based upon a study of the outbreak in the Byculla House of Correction, 1897, and dated 15th February 1897, was sent to him and forwarded to His Excellency the Governor. A copy was sent also to the Secretary to the Government of India, Home Department.

(E.)

Difficulties which were met with in introducing preventive inoculation among the races in India were referred to in my address quoted above to the first Indian Medical Congress, Calcutta, 1894. I must acknowledge the great help rendered to me during the first and most difficult stages of these efforts by Mr. E. H. Hankin, M.A., Chemical Examiner and Bacteriologist to the Governments of the then North-West Provinces and Oudh, and the Central Provinces. The problem was solved, in every instance, in the way described in my evidence to the Indian Plague Commission, Volume I, page 11 of their Report. A number of officers who assisted me in my operations were successful afterwards in adopting the same plan. As exceptionally good instances may be quoted : the work of the late Captain Leumann, I. M. S., with whom I introduced the inoculation in Lonávla, in 1897, and who, in the year following, applied it on a large scale in the Southern Marátha Country. Together with his assistants, he inoculated, for the first time, whole populations of towns, notably in Hubli, Dhárwár and Gadag. In 1893, Captain C. H. James, I. M. S., worked with me in many of the places in the Punjáb, in which I was carrying on anti-cholera inoculation (Sanawar, Kasauli, Dagshai, Simla, Patiala, Sangrur, Rawalpindi, Murree, Abbottabad,

Nowshera, Peshawar, Amritsar, Dharamsala, Kapurthala, Wazirabad, Lahore, Mian Mir, Sialkot, and other places and villages adjacent to them). He and Captain E. Wilkinson, I. M. S., who was deputed by the Government of the Punjab to study inoculation work in the Bombay Laboratory in 1897, at the time when many hundreds of people were daily operated on there, were afterwards phenomenally successful in the Punjab inoculation work of 1900-1901. The latter officer must be mentioned as having inoculated with his own hand the largest number of people ever done in a day by a single operator, *viz.*, 3,200. Major Bannerman, I. M. S., was sent to the Laboratory by the Government of Madras to learn the procedure, at the same time as Captain Wilkinson; and on returning to his Presidency introduced inoculation in various places, long before any plague appeared there, as well as in the plague-stricken cantonment of Belgaum. Professor A. E. Wright, of Netley, during his visit to India in 1898-99, applied anti-typhoid inoculation for the first time to large numbers of people here, and was good enough to acknowledge, in the discussions at the Royal Society, of the 8th June 1899, that the work done by him "had been facilitated by the fact that wherever he went, Mr. Haffkine had been previously." (*British Medical Journal*, July 1st, 1899.)

Amongst the vast number of other Commissioned and subordinate medical officers and private practitioners, European and Native, who attended at the Laboratory to study the inoculation work, may be mentioned Lieutenant-Colonels J. Arnott, H. Boyd and Barker, I. M. S., and Dr. (Miss) Benson (Bombay Government Resolution No. ^{1592-P.}₁₀₄₇ of 20th March 1897); Lieutenant-Colonels Dimmock, Lyons, Majors Childe, Herbert, Hojel and A. Street, I. M. S., Bombay; Captain Dawson, I. M. S., deputed by the Government of the (then) North-Western Provinces; Captain Dove, deputed by the Principal Medical Officer, Bombay Command; Dr. H. Markes Fernando, deputed by the Government of Ceylon; Assistant Surgeon Katak, sent by the Sanitary Commissioner, Bombay; a deputation of Doctors sent by H. H. the Nizám's Government, Hyderabad (Deccan); Dr. M. Shrinivasarao, deputed by the Mysore Government; Assistant Surgeon G. Chitnis, deputed by the Government of Baroda, as well as Drs. S. M. Daulatjada, D. H. Mehta, N. D. Desai, G. B. Paranjpe, C. D. Dewanji and S. M. Dave, instructed, for the same Government, in Baroda itself; Dr. R. Unwalla, deputed by the Bhávnagar State; Dr. Nizamudin Pirally Bawa, recommended for instruction by the Political Agent, Káthiáwár; Dr. Ranade, recommended by the Diván of Wádhwán State; Drs. Shroff, Murphy, de Quadros, Miss Bradley, and a number of others, sent by the Health Officer of Bombay; Drs. McCabe Dallas, K. S. Engineer, D. M. deSilva, A. W. Dyer, Patel, S. B. Pocha, V. S. Trilokekar, S. B. Naik, Sorabji Aderji Doctor, and very many others. Those who afterwards assisted these operators in their work contributed to spread the inoculation over the territory of the country.

(F.)

In the lists given above, *viz.*, on pages 6, 7 and 10, the countries outside India have been enumerated in which the plague inoculation was introduced and prophylactic supplied for it by the Laboratory during the years 1897—1902. Several Institutions abroad have now taken over the manufacturing of the material. Amongst these may be mentioned the Laboratory at the St. Bartholomew's Hospital and College, London, under Professor E. Klein; the Jenner Institute of Preventive Medicine, London; the Thomson Yates Laboratories, University College, Liverpool, from which the War and Colonial Offices have been supplied; the Imperial Institute of Experimental Medicine in St. Petersburg, where the material is prepared for use in European and Asiatic Russias; the Swiss Bacterio-therapeutic and Vaccinal Institute, Bern; the Government Plague Laboratory, in Pianosa, Italy; the Laboratory of the Insular Board of Health, Manila, Philippine Islands. Some druggists' firms, like Messrs. Rebman, Limited, London, are manufacturing and dispensing it on a commercial basis, on their own behalf.

(2).—STUDIES ON STERILISATION AND DISINFECTION.

The work on plague preventive inoculation absorbed unavoidably the largest part of the Laboratory's energies, in view of its great urgency. Our studies on the plague comprised, further, the following :—

- Pathological studies ;
- Studies on the antitoxic serum treatment ;
- Experiments in serum diagnosis ;
- Examination of plague suspected animals, stuffs, cultures and patients ;
- Researches on the plague bacillus in Nature ; and .
- Studies in disinfection.

This work is recorded below in the order of its practical significance.

The following Laboratory reports under the head of sterilization and disinfection were published by Government :—

Letter No. 105 of 21st April 1898, to the Surgeon-General with the Government of Bombay, forwarding report on experiments made in the Laboratory by Drs. E. L. Marsh and W. W. Pitchford, on the Equifex Disinfection Stove.

Letter No. 399 of 23rd July 1898, forwarding report on experiments made by Dr. E. L. Marsh on the Bowman Steam Disinfector.

(The two printed in accordance with Bombay Government Resolution No. ⁴⁸⁰³_{5091-P.} of 27th April 1898).

Letter No. 21 of 18th February 1898, to Surgeon-General with the Government of Bombay, forwarding report of experiments on liquid sulphur dioxide and carbolic fumes as carried out in the Plague Research Laboratory by Major Bannerman, I. M. S.

Letter No. 79 of 2nd April 1898, to Surgeon-General, forwarding a summarised report on experiments with sulphur dioxide and the bacillus of plague, by Dr. E. L. Marsh of this Laboratory.

Letter No. 316 of 30th June 1898, to Surgeon-General, forwarding report by Drs. E. L. Marsh and W. Watkins Pitchford on the efficiency of vaporised carbolic acid as a disinfectant, with special reference to the bacillus of bubonic plague.

Further report on the action of liquefied sulphur dioxide as a disinfectant, with special reference to the bacillus of bubonic plague, by the same officers, with Mr. Haffkine's summary and conclusions.

Report dated 30th June 1898 on the efficiency of nitric fumes as a disinfectant, with special reference to the bacillus of bubonic plague, by the same officers of the Laboratory.

The five last mentioned reports were printed by Government Resolution No. ^{4740-P.}₅₀₀₇ of 24th August 1898.

Report on the efficiency of perchloride of mercury in disinfectant solution, as an application to cowdung floors ; and on the utility of saturating cowdung (or simply mud) floors with sea water before spraying them with perchloride of mercury, by Dr. E. L. Marsh, 14th March 1899 (Bombay Government Central Press).

Report on the disinfection of Native Dwellings by Formaldehyde Vapour, with special reference to the utility of the apparatus of Lingner, by Dr. E. L. Marsh, 14th September 1899. (Printed in the Bombay Government Central Press.)

Dr. Marsh's experiments included also an investigation on the number of microbes in general found in houses roofed and unroofed, disinfected

and not disinfected; and also on the relation of the plague bacillus to water, earth, sterilised and unsterilised, also on plague cultures exposed to the effect of sub-soil air, &c. A reference to these experiments was made in his evidence to the Plague Commission, Volume III, page 68.

Letter No. 1541 of 28th August 1901 and letter No. 2412 of ^{23rd}_{24th} December 1901, to Government forwarding reports on the experiments made by Captain Liston, I. M. S., of the Plague Research Laboratory, on the effect of the addition of "New Green Crystals" to perchloride of mercury and on the disinfecting and staining properties of that dye, printed in preamble to Government Resolution No. 1346-P. of 15th April 1902.

Letter No. 1880 of 14th October 1901 on the cheapest disinfectants; forwarding report on experiments made by Captain Liston, I. M. S., printed in the preamble to Government Resolution No. 4805 of 10th December 1901.

The following may also be mentioned :—

"The procedure adopted in the Plague Research Laboratory for stoppering the plague prophylactic bottles, and on the sterilisation of India-rubber and ordinary corks", by Mr. M. K. Pansare, L. M., Supervisor, Plague Research Laboratory, published in the "*Indian Medical Gazette*", December 1900.

Some other Laboratory studies and reports on disinfectants are mentioned below, on page 38.

A special formalin disinfecting machine, for disinfecting boots and shoes of native crews serving on out-going vessels, has been constructed and supplied to the Port Health Officer, Bombay (*vide* letters to Government, Nos. 1510 of 23rd August 1901, 242 of 12th February 1902, and 526 of 24th February 1903). In the course of the investigations connected with this matter, it was found that it is much easier to deprive the plague bacillus of its power of growing in artificial media than to make it harmless to rats; that the latter possess the power of revivifying an apparently disinfected plague culture; suffer from it a fatal disease, and restore it, during this process, to its primitive vigour.

(3).—EXAMINATION OF PLAGUE-SUSPECTED PATIENTS, ANIMALS AND STUFFS.

The number of living and dead animals, rats, mice, monkeys, squirrels, dogs, cats, birds, examined in regard to plague, for Government officers, the Municipality, and private applicants, amounts to a very large number, but cannot be given in accurate figures.

In 1897 the Laboratory investigated an outbreak of plague among monkeys in Hardwar (*vide* Report to the Secretary to the Government of India, Home Department, dated Hardwar, 25th November 1897).

Cases of plague among monkeys and squirrels in Dhárwár were further studied by Dr. (Miss) Corthorn and Captain Ch. Robertson Milne, I. M. S., then of this Laboratory, and the result published in the *Bombay Government Gazette*.

The infectiveness or otherwise of food-stuffs was tested in a number of instances, always with negative results.

Only on one occasion did it happen that a number of rats inoculated with flour and farinaceous articles, removed from a plague infected shop, died. No plague microbes were detected in their bodies, and the cause of their deaths could not be ascertained, the samples having been inadvertently destroyed. This was in connection with 15 articles of food-stuffs sent for investigation by the Medical Adviser to His Highness the Mahārāja of Patiala, with his letter No. 946 of 7th February 1902.

Experiments on milk and ghi were referred to in my evidence to the Indian Plague Commission, Vol. I., p. 15.

(4).—PATHOLOGICAL STUDIES.

Dr. F. M. Gibson and Captain Ch. Robertson Milne, I. M. S., studied the infectiveness of secretions from plague infected rats (*vide* Captain Milne's evidence to the Indian Plague Commission, Vol. III, p. 24).

The Laboratory examined a number of samples of blood and pathological products and tissues from plague stricken patients.

Thus in March to May 1898 Dr. C. H. Cayley, then of this Laboratory, investigated discharges from plague patients, their saliva, epidermis of tongue, sputum in pneumonia cases, and demonstrated in all of these the presence of plague bacilli, but found them absent in perspiration and urine. Reference to these experiments was made in his evidence to the Indian Plague Commission, Vol. III, p. 294 of their report.

The same officer made also an enquiry into the length of time during which plague bacilli are recoverable in the sputum and other products of people sick and recovering from plague pneumonia. For results *vide* evidence given by him to the Indian Plague Commission, Vol. III, pages 293-294 of their report.

In February to March 1902, Captain Greig, I. M. S., of this Laboratory, made a study of the presence or otherwise of bacilli in the blood of plague-stricken patients, as observed in the epidemic of that season. These studies were made partly in connection with Dr. Costello's investigation on the effect of Lustig's serum in the Poona General Plague Hospital, in February to March 1902 (*vide* that officer's report No. 2297, dated 29th April 1902, and Government of Bombay, General Department, letter No. 1877-P. of 16th June 1902).

The question as to the possibility of conveying plague by food was studied on a considerable scale, by Dr. F. M. Gibson. Notwithstanding the great variation of conditions, in no instance could the disease be communicated even to such animals as showed themselves very susceptible when inoculated afterwards under the skin. The materials experimented with included grain freshly and abundantly infected with virulent plague cultures. The same officer studied also the communicability of plague from rat to rat.

Certain pathological studies made by me in 1896 and 1897 remain still unpublished.

(5).—RESEARCHES ON THE PLAGUE BACILLUS IN NATURE, OUTSIDE THE HUMAN AND ANIMAL BODY.

Dr. C. H. Cayley, M.A., M.B., was first put on this investigation, in 1898. Various methods proposed by investigators and others suggested by us, for recovering plague bacilli from soil and other materials, were tested by him in March to May of that year, and attempts made to detect the bacilli in articles which were likely to be naturally infected, such as clothes from patients, earth in infected rooms and from plague grave-yards, cotton matting, hangings in patient's rooms, etc. No plague microbes were found, except on one occasion, on a piece of matting directly soiled by a plague patient. In the same year and in 1899 Dr. Ransome and Captain Milne were put on to test articles removed from infected rooms. In a large number of attempts made, only on one occasion, again, was a plague culture obtained, *viz.*, in a sample of dust sweepings collected by Dr. Ransome, a result which may have been due to some accidental contamination.

Ultimately Dr. F. M. Gibson was deputed to carry out a series of experiments First in Bombay, and afterwards (June to September 1898) in Karachi (*vide* Government Resolution, No. 3572 of 4th June 1898). His experiments were made upon soil, clothing, bedding, furniture, food-stuffs, gunny-bags, grain and other articles which were likely to have been infected by plague rats. In no instance could the plague microbe be detected.

The method used for searching for these microbes was described in my evidence to the Indian Plague Commission, Vol. I, page 15 of their report.

(6).—EXPERIMENTS ON SERUM DIAGNOSIS IN PLAGUE.

These were made by Dr. Gibson and, under his guidance, by Dr. (Miss) Alice Corthorn.

The object was to ascertain whether serum separated from clotted blood of patients sick or convalescent, and of persons inoculated against the plague, had an effect on an emulsion of plague microbes, similar to that observed in enteric, Malta fever, and some other diseases.

Difficulties that so far have not been overcome were met with in the preparation of a satisfactory emulsion of the plague bacillus. An emulsion prepared by shaking up a 48 hours' growth off agar with distilled water and sand, seemed satisfactory, but was found to be precipitated by normal human serum as well as by that of persons inoculated against the plague. This may have been due to the omission of $\frac{3}{4}$ per cent. of salt in the preparation of the emulsion. Later attempts at making an emulsion on that plan proved abortive, possibly for want of proper sand. As regards plague patients a further difficulty was met with in the fact that in acute cases the blood could not be got to clot. A clear serum could not therefore be obtained. Whether this reaction can be profitably applied to plague, with improved methods or not, remains for the present undecided.

(7).—EXPERIMENTS ON A CURATIVE SERUM FOR PLAGUE.

Dr. Yersin, previously of the Pasteur Institute in Paris, who had been investigating the plague in Hongkong, in 1894, and since then pursued his studies in his laboratory, in Indo-China, and in the Pasteur Institute, in Paris, published in 1896, shortly before the outbreak in Bombay, the results of his experiments on a curative serum for treating that disease. According to this publication, serum of horses treated with plague cultures, upon the same lines as it had been done for the preparation of an anti-diphtheritic serum by Behring and Kitasato, obtained the property, when injected in plague patients, of reducing their mortality from some 90 per cent. down to 7 per cent.

On my arrival in Bombay, in the beginning of the outbreak here, I undertook experiments on small Laboratory animals, on a limited scale, with the object of, first, carrying out a tentative study on the properties described by Yersin. It was however known from experiments on diphtheria and tetanus, that the preparation of such serum, whether in small or large quantities, required many months of continued treatment of animals from whom the serum was to be obtained. On the strength of Dr. Yersin's statements, the Health Department of the Municipality asked that the preparation of such serum should be undertaken at once on a scale adequate to the outbreak in the city.

The preparation on a plan similar to that announced by Dr. Yersin, began in November 1896, and towards the middle of April 1897, 52 horses, 14 cattle and 119 goats and sheep were under treatment. In October 1897, I had collected an amount of serum sufficient for submitting the treatment to a conclusive test, and carried out this in the Poona Plague Hospital, with the assistance of Dr. W. J. Simpson and Major Bannerman, I. M. S. My results were of an entirely negative character. By the end of the same month I reduced the number of animals to 9 horses, 3 cattle and 3 sheep, on which certain further studies were carried on. The animals were finally disposed off upon my letter to the Municipal Commissioner, No. 62 of 25th March 1898 (*vide* this office letter to the Executive Health Officer, Bombay Municipality, No. 1048 of 10th December 1898).

The method of testing the serum which I adopted, and which I consider the only accurate one, as well as the general results of my experiments, were

explained to the Indian Plague Commission, Vol. I of their Report, pages 13—15. During my experiments, I found the serum of sheep more promising than that of other animals. This serum will be again experimented with in this Laboratory.

The above experiments decided the question of anti-toxic treatment in plague in a way which has not been controverted since. In addition to this, the following facts were for the first time established in the course of those studies:—

- (1) That none of the larger domestic animals, cows, horses, bulls, sheep, goats, contract plague; only goats waste gradually away under the effect of the artificial infection (*vide* p. 38, Vol. I, of Mr. Nathan's "The Plague in India in 1896-1897").
- (2) In man hardly any difference in re-action is observed if he be re-inoculated a few days after a first inoculation, and only a slightly lesser re-action is observed if he be inoculated a long time after the first. Nevertheless a continued series of inoculations tried on animals shows that they get more and more insensible to the virus. Thus a horse which re-acted at first violently to, say, 5 c.c. of a plague culture, may after several months of treatment, show only slight fever subsequent to an injection of some 1,600 c.c.; and
- (3) That there exist such a thing as local immunity, as explained to the Indian Plague Commission, Vol. I, page 13.

A detailed enquiry into the results obtained from sera prepared by Professor Lustig, Florence, and Professor Terni and Dr. Bandi, Messina, was carried out in the Laboratory, with results similar to those observed in 1897.

II.

STUDIES IN DISEASES OTHER THAN PLAGUE.

As stated above, the activity of the Laboratory has been, during the years under report, connected mainly with work on plague. As far, however, as circumstances permitted, a certain amount of work has been done also in other directions, namely in connection with Cholera, Typhoid, Malta or Mediterranean fever, Relapsing fever, Scurvy, Snake venom and antivenene, Diphtheria, Leprosy, Variola and Vaccinia, Malarice, Epizootic lymphangitis, and Surra.

A.—PRACTICAL AND RESEARCH WORK ON CHOLERA.

This comprised :

(1) Studies on the distribution of cholera bacilli in nature, carried out in the following places :—

In Bombay: *vide* this office report dated 4th August 1897, in reply to letter from Municipal Commissioner, No. 10512 of 28th July 1897, asking for the examination of Bombay waters.

In Gujarát, during the 1900 famine: Report to Government of Bombay, No. 1191 of 25th July 1900.

In the Ahmednagar Boer Camp, undertaken upon the request of the Principal Medical Officer, Bombay, wire dated 29th May 1901, and continued till 25th October 1901. Results reported to the Senior Medical Officer in charge of the Camp.

Apart from the above, a large number of samples of cholera suspected waters were examined in the Laboratory on application from various sources.

(2) Study of the effect on man of various forms and doses of cholera vaccine, carried out by Major A. Buchanan, I. M. S., Superintendent, Nágpur Central Jail, and Captain G. Lamb, I. M. S., of this Laboratory. Contributed to the Scientific Memoirs edited on behalf of the Government of India by the Director-General, Indian Medical Service, with this office letter No. 2356 of 14th December 1901 and summarised in that officer's Annual Report for 1900.

(3) Experiments in Baroda, by Captain Lamb, I. M. S., and myself, on the effect on men of a comma bacillus not agglutinating with the serum of animals immunized to the cholera comma bacilli.

(4) A certain number of officers were also taught the *technique* of anti-cholera inoculation, upon the request of the Surgeon-General with the Government of Bombay, dated 11th June 1901.

B.—PRACTICAL AND RESEARCH WORK ON ENTERIC FEVER.

(1).—PREPARATION AND DESPATCH OF ANTI-TYPHOID VACCINE.

(a)

One hundred and fifty doses of this vaccine were prepared and distributed to applicants in 1900-1901, and one hundred and sixty-nine in 1901-1902, as detailed in the lists below.

Statement showing the amount of Anti-Typhoid Vaccine supplied to various places from the Research Laboratory, Bombay, between 1st June 1900 and 31st May 1901.

(Total 150 adult doses.)

Date of despatch.	To whom and where sent.	Number of doses.
	BOMBAY PRESIDENCY.	
	BOMBAY.	
16th October 1900 ...	Medical Storekeeper to Government, Bombay Com- mand	72
	DEOLA'LI.	
22nd December 1900 ...	Senior Medical Officer	78
	Total ...	150

Statement showing the amount of Anti-Typhoid Vaccine supplied to various places from the Research Laboratory, Bombay, between 1st June 1901 and 31st May 1902.

(Total 169 adult doses.)

Date of despatch.	To whom and where sent.	Number of doses.
	BOMBAY PRESIDENCY.	
	ADEN.	
	<i>Sheik Ottaman.</i>	
20th December 1901 ...	Dr. J. C. Young	8
	MAHA'BLESHWAR.	
21st May 1902 ...	Superintendent	12
	POONA.	
20th August 1901 ...	Lieut.-Colonel G. H. Bull, I. M. S. ...	27
21st August 1901 ...	Principal Medical Officer	50
	Total for Bombay Presidency ...	97
	CENTRAL INDIA.	
	NEEMUCH.	
26th May 1902 ...	Senior Medical Officer	43
	THE PUNJAB.	
	MUSSOOREE.	
21st May 1902 ...	Civil Surgeon	6
	SIALKOT.	
13th March 1902 to 21st May 1902.	Civil Surgeon	6
	Total for the Punjab ...	12
	NATIVE STATES.	
	HYDERABAD (DECCAN).	
23rd May 1902 ...	The Plague Commissioner	12
	Grand Total ...	169

(b)

The typhoid vaccine issued from this Laboratory was prepared in accordance with the ideas explained in this office letter No. 260-A of 7th June 1898, to the Government of India.

The strength of the bacillus was kept up by the same method of passages through guinea pigs as I introduced in cholera. A richly sown broth culture of virulent typhoid bacilli in broth was prepared and left to stand for 10 days. The typhoid bacillus grows much more rapidly than that of plague, and a richer cultivation is obtained within the above time than can be had from plague bacilli in a corresponding number of weeks.

Twenty-four hours before the cultivation is completed, an agar growth of the bacillus is started. On the tenth day of growth the liquid culture is introduced into the vessel containing the 24th hours' agar culture, and the surface growth of the latter is washed off and mixed with the broth culture. The mixture is sterilised by heating for 20 minutes at 60° C. In this way a young, one day old, vigorous mass of bodies of bacilli, taken off the agar, is combined with the products accumulated in the ten days' old liquid cultivation,

(c)

The following references show the connection of the typhoid vaccine with that of cholera and plague: Professor E. A. Wright and Surgeon-Major D. Bruce, A.M.S., "On Haffkine's method of vaccination against Asiatic Cholera," *British Medical Journal*, February 4th, 1893; Dr. Tamamcheff "Expériences sur les vaccins phéniqués de Haffkine," *Annales de l'Institut Pasteur*, 1892, p. 713; and Dr. G. Lawein, "Observations sur des cobayes immunisés par les vaccins anti-cholériques vivants," same volume, p. 708; Surgeon-Captain C. C. Manifold, M.B., I. M.S., "Report of a case of inoculation with carbolised anti-choleric vaccine (Haffkine)," *Indian Medical Gazette*, April 1893, p. 101; E. H. Hankin, "Annual Report of the Chemical Examiner and Bacteriologist to the Governments of the North-Western Provinces and Oudh and of the Central Provinces for the year 1894," Allahabad, Government Press, 1895; Professor R. Pfeiffer and Dr. W. Kolle, "Experimentelle Untersuchungen Zur Frage der Schutzimpfung des Menschen gegen Typhus abdominalis," in the *Deutsche Medicinische Wochenschrift*, No. 46, 1896, and in the *Indian Medical Gazette*, 1897; A. E. Wright, M.D., and Surgeon-Major D. Semple, M.D., I. M.S., "Remarks on vaccination against typhoid fever," *British Medical Journal*, January 30th, 1897, p. 256; W. M. Haffkine, "Inoculation against Plague," *British Medical Journal*, May 1897; and letter to the Secretary to the Government of India, Home Department, dated 14th July 1897 in Mr. Nathan's "The Plague in India in 1896-1897," Volume II, p. 36; W. M. Haffkine, "On Preventive Inoculations," Proceedings of the Royal Society, London, Volume LXV above quoted; "Discussion of Preventive Inoculation," *British Medical Journal*, July 1st, 1899; Professor A. E. Wright, letter in the *British Medical Journal*, July 8th, 1899, p. 199; and Indian Plague Commission, page 183, Volume V of their Report.

(2).—INVESTIGATION OF TYPHOID SUSPECTED WATERS.

A number of samples of water were examined at the Laboratory for the presence of typhoid-like bacilli and those of the *coli* class. This was done, amongst others, on the waters of the Ahmednagar Boer Camp in September 1901, upon an application from Lieutenant-Colonel Lane, R.A.M.C. A note referring to these studies was forwarded to the Director-General, Indian Medical Service, with this office No. 2413 of 24/25th December 1901,

(3).—SERUM DIAGNOSIS OF ENTERIC.

The Laboratory manufactured and supplied materials for the diagnosis of the disease by means of Widal's method, which consists, as has been mentioned above in making a drop of serum, obtained from the blood of a suspected patient, act upon the microbes of that disease suspended in a saline solution. A lecture explaining the method was delivered by Captain Lamb, I. M. S., of this Laboratory, in the Bombay Medical and Physical Society and subsequently published in their proceedings, as well as in the *Indian Medical Gazette* and also by the Director-General, Indian Medical Service.

By means of this method rather numerous cases of the disease were detected in Natives of India, *viz.* in Bombay and in Poona. A report on the matter by Captain Lamb, I. M. S., was submitted to the Government of Bombay with this office letter No. 49 of 10th January 1901 and published in the *Bombay Government Gazette Extraordinary* of 7th May 1901, page 797 and following. Another report was sent to the Sanitary Commissioner with the Government of India for publication in the *Scientific Memoirs*, with this office No. 1155 of 29th May 1902.

In 1900-1901, 825 blood capsules, 885 sedimentation tubes, 138 capsules of microbial emulsion, and 38 special lamp collars and tubes, were issued to various officers for the diagnosis of typhoid and Malta fevers by means of the method in question. In 1901-1902 the figures were 1,007, 1,164, 151 and 8.

A certain number of officers were admitted to the Laboratory and taught the method personally.

The apparently wide distribution of the disease amongst the Natives of India must now be taken into account whenever measures are discussed for the prevention of enteric. Formerly the British troops and the general European population in India were supposed to be the main, if not the only, sufferers from, and disseminators of, this disease.

C.—MALTA FEVER.

By means of Widal's re-action applied to Malta (or Mediterranean) fever a number of cases were diagnosed among Europeans and Natives of India. The recognition of indigenous cases out here has an interest from the point of the geographical distribution of the disease, so far only very imperfectly known. A report by Captain Lamb, I. M. S., of this Laboratory "On the occurrence of Mediterranean fever in Bombay," was published in the Government Central Press, Bombay, 1900.

D.—RELAPSING FEVER.

In connection with the outbreak of the disease in one of the Bombay Jails, Captain G. Lamb made a series of experiments on Relapsing fever in Monkeys. A paper by him on the subject has been published in the "Scientific Memoirs of Medical Officers of the Army in India," Part XII, 1901, pp. 77—102.

E.—SCURVY.

Experiments by the same Officer were carried out with the object of testing theories so far advanced as to the manner of propagation of this disease. These experiments were published in the "Lancet," London, January 4th, 1902, pp. 10—14.

F.—SNAKE VENOM AND ANTIVENENE.

(1).—TESTING SAMPLES OF ANTIVENENE.

In order to test the efficacy and keeping properties of Calmette's antivenene, samples collected in Bombay, Nasik, Indore, Agra, Berar were examined by Captain Lamb and Dr. Hanna of this Laboratory. The samples had been kept in the respective places from 2 months to 5 years. It was found that the efficacy of the material when tested on animals injected with cobra poison is undoubted, that its power gets gradually reduced, and that the latter process is quicker in hotter parts of the country. After some three years the serum seems to lose its power entirely. A report on these results was forwarded to the Government of India through the Government of Bombay with this office letter No. 689 of 19th April 1901, and appeared in the Scientific Memoirs edited by the Sanitary Commissioner with the Government of India, New Series, No. 1, 1902.

(2).—COLLECTION OF SNAKE VENOM.

An arrangement was made, by the sanction of Government, with Dr. Calmette Lille, the discoverer of antivenene, for the exchange of his serum for dry venom, which he required for his preparations. For this purpose 772 snakes (Cobras, Russell's Vipers, *Echis carinata* and *Bungarus Fasciatus*) (686 live and 86 dead) were collected by the Laboratory. The districts and officers who contributed this large number of reptiles are given in the attached lists. Over 1,000 grammes of dry cobra venom, 50 grammes of dry daboia venom, 5 grammes of that of *bungarus fasciatus* and about 5 milligrammes of that of *echis carinata* was collected from these snakes.

Statement showing the number of Snakes received at the Plague Research Laboratory, Bombay, up to 31st May 1900.

(Total No. 3.)

Name of Town.	Presidency, etc., Sender's Name and designation.	Date.	Cobras.	Total.
	<i>Bombay Presidency.</i>			
Bombay	Purchased by Laboratory ...	10th April 1900 to 23rd May 1900.	3	3

Statement showing the number of Snakes received at the Plague Research Laboratory from 1st June 1900 to 31st May 1901.

(Total No. 19.)

Name of Town.	Presidency, etc., Sender's name and designation.	Date.	Cobras.	Russell's Vipers.	Total.
	<i>Bombay Presidency.</i>				
Bombay	Purchased by Laboratory	27th June 1900 to 16th April 1901.	9	10	19

*Statement showing the number of live Snakes received at the Plague Research Laboratory,
Bombay, from different parts of India between 1st June 1901 and 31st May 1902.*

* (Total No. 671.)

Name of Town.	Presidency, &c., Sender's Name and Designation.	Date of receipt.	DESIGNATION OF SNAKE.				Total number of Snakes received.
			Naja Tripudians.	Daboia Russellii.	Echis carinata.	Bungarus Fasciatus.	
<i>Bombay Presidency.</i>							
Bombay ...	Purchased by Laboratory ...	1st June 1901 to 20th May 1902.	3	6	...	...	9
Thána ...	Assistant Surgeon F. A. Moos, Khán Bahádúr, Acting Civil Surgeon.	30th August 1901 ...	...	1	...	...	1
Total for Bombay Presidency ...			3	7	...	...	10
<i>Bengal Presidency.</i>							
Alipore ...	C. J. Stevenson Moore, Esq., C. S., Officiating Magistrate, 24-Parganas.	20th February 1902 to 17th May 1902.	8	6	...	1	15
Balasore ...	Captain W. A. Williams, I. M. S., Civil Surgeon and Superintendent of Vaccination.	9th November 1901 .	10	...	...	...	10
Bankura ...	B. De, Esquire, C. S., Magistrate.	7th January 1902 ...	11	...	...	...	11
Barisal ...	Lieut-Colonel R. Cobb, I. M. S., Civil Surgeon.	29th November 1901 .	3	...	...	...	3
Hooghly...	T. English, Esquire, C. S., Magistrate.	6th December 1901 to 28th January 1902.	10	...	...	...	10
Howrah ...	F. W. Duke, Esquire, C. S., Magistrate.	5th November 1901 to 16th December 1901.	13	11	...	...	24
Jessore ...	A. G. Hallifax, Esquire, C. S., Magistrate.	26th February 1902 .	5	...	...	...	5
Midnapore ...	W. A. Marr, Esquire, C. S., Magistrate.	18th November 1901 .	48	...	...	...	48
Total for Bengal Presidency ...			108	17	...	1	123
<i>Central Provinces.</i>							
Bhandara ...	E. J. Murphy, Esquire, Civil Surgeon.	19th October 1901 to 25th January 1902 .	...	4	...	...	4
Damoh ...	T. W. Quinn, L.R.C.P., &c., Civil Surgeon.	5th October 1901 to 28th April 1902 ...	27	7	...	...	34
Hoshangabad ...	Major A. G. Hendley, I. M. S., Civil Surgeon.	4th October 1901 to 16th October 1901 .	3	...	...	...	3
Jubbulpore ...	Lieut-Colonel H. K. McKay, I. M. S., C.I.E., Civil Surgeon.	14th October 1901 to 14th February 1902.	14	2	...	...	16
Nágpur ...	Major A. Buchanan, M.D., I. M. S., Civil Surgeon.	14th October 1901 ..	1	...	...	...	1
Narsinghpur ...	Captain G. Murphy, I. M. S., Civil Surgeon.	9th October 1901 to 18th May 1902 ...	23	8	1	...	32
Khandwa ...	Major H. E. Banatvala, I. M. S., Civil Surgeon.	23rd October 1901 to 20th May 1902 ...	323	40	6	...	369
Raipur ...	Captain P. F. Chapman, I. M. S., Civil Surgeon.	27th December 1901 to 25th March 1902.	4	...	...	2	6
Sambalpur ...	Assistant Surgeon D. O'Connell Murphy, Civil Surgeon.	9th October 1901 to 31st March 1902 ...	19	...	...	...	19
Saugor ...	Captain W. D. Sutherland, M.B., I. M. S., Civil Surgeon.	4th October 1901 to 30th December 1901.	13	4	...	...	17
Total for Central Provinces ...			427	65	7	2	501

Name of Town.	Presidency, &c., Sender's Name and Designation.	Date of receipt.	DESIGNATION OF SNAKE.				Total number of Snakes received.
			Naja Tripudians.	Daboia Russellii.	Echis carinata.	Bungarus fasciatus.	
	<i>Madras Presidency.</i>						
Anantapur	Bannatyne Macleod, Esq., M.A., Barrister-at-Law, Collector.	25th October 1901 to 6th February 1902.	3	...	...	...	3
Vizagapatam	Captain W. Vickers, I. M. S., District Medical and Sanitary Officer.	15th October 1901 to 4th November 1901.	6	...	...	...	6
	Total for Madras Presidency	...	9	...	...	...	9
	<i>United Provinces of Agra and Oudh.</i>						
Gorakhpur	Major G. H. Baker, I. M. S., Civil Surgeon.	18th February 1902 to 6th May 1902.	12	...	...	...	12
Mirzapur	Major R. J. Marks, I. M. S., Civil Surgeon.	16 December 1901 ...	7	...	...	...	7
	Total for United Provinces	...	19	...	...	...	19
	<i>Native States, Nizám's Dominion.</i>						
Bolarum	Honorary Lieut. Mahoney, I. S. M. D.	5th August 1901 ...	3	1	...	...	4
	<i>Orissa.</i>						
Barumba	Babu Madan Mohan Patnaill, Manager, Barumba State.	25th March 1902 ...	2	...	...	...	2
	Total for Native States		5	1	...	...	6
	Grand Total	...	571	90	7	3	671

(3).—SUPPLY OF ANTIVENENE TO HOSPITALS AND DISPENSARIES.

Between October 1901 and 21st April 1902, 632 bottles of Calmette's antivenene were distributed to hospitals and dispensaries in the Bengal Presidency, Central Provinces, the Punjáb, Rájputána, the United Provinces and Káshmir. Considerable orders from Burma, United Provinces, Central Province and the North-West Frontier Province are awaiting compliance. The arrangements with Dr. Calmette fell through, as he declared himself unable to make use of large quantities of venom. The preparation of his antivenene, according to the method published by him and very kindly supplemented by details communicated by him to the Laboratory, has therefore been started in this Laboratory. Certain promising modifications are being attempted, and these will be in due time reported on, and published.

*Statement showing the amount of Antivenene supplied to various places from the Research Laboratory,
Bombay, between the 16th October 1901 and 21st April 1902.*

(Total number of bottles, 632).

Date.	Name of Presidency and Districts and date of despatch.	Number of bottles supplied.	Date.	Name of Presidency and Districts and date of despatch.	Number of bottles supplied.
	BENGAL PRESIDENCY.			BENGAL PRESIDENCY— continued.	
	<i>Bhagalpur.</i>			<i>Ranchi.</i>	
25th February 1902 ...	Civil Surgeon ...	6	10th March 1902 ...	Civil Surgeon ...	10
	<i>Burdwan.</i>			<i>Saran.</i>	
25th February 1902 ...	Civil Surgeon... ..	6	10th March 1902 ...	Civil Surgeon ...	6
	<i>Champaran.</i>			Total, Bengal Presidency ...	203
25th February 1902 ...	Civil Surgeon ...	24		CENTRAL PROVINCES.	
	<i>Cuttack.</i>			<i>Nagpur.</i>	
25th February 1902 ...	Civil Surgeon ...	5	10th January 1902 to 18th April 1902.	Administrative Medical Officer.	290
	<i>Darbhanga.</i>			THE PUNJAB.	
10th March 1902 ...	Civil Surgeon ...	10		<i>Amritsar.</i>	
	<i>Faridpur.</i>			<i>Delhi.</i>	
10th March 1902 ...	Civil Surgeon ...	10	1st April 1902 ...	Civil Surgeon ...	4
	<i>Gaya.</i>			<i>Ferozepore.</i>	
25th February 1902 ...	Civil Surgeon ...	12	1st April 1902 ...	Civil Surgeon ...	4
	<i>Hazaribagh.</i>			<i>Gurdaspur.</i>	
10th March 1902 ...	Civil Surgeon ...	12	1st April 1902 ...	Civil Surgeon ...	4
	<i>Howrah.</i>			<i>Gujarat.</i>	
25th February 1902 ...	Civil Surgeon ...	6	1st April 1902 ...	Civil Surgeon ...	4
	<i>Hugli.</i>			<i>Hoshiarpur.</i>	
10th March 1902 ...	Civil Surgeon ...	4	1st April 1902 ...	Civil Surgeon ...	4
	<i>Midnapur.</i>			<i>Jullunder.</i>	
10th March 1902 ...	Civil Surgeon ...	12	1st April 1902 ...	Civil Surgeon ...	4
	<i>Monghyr.</i>			<i>Karnal.</i>	
25th February 1902 ...	Civil Surgeon ...	24	1st April 1902 ...	Civil Surgeon ...	4
	<i>Murshidabad.</i>			<i>Lahore.</i>	
10th March 1902 ...	Civil Surgeon ...	10	1st April 1902 ...	Civil Surgeon ...	4
	<i>Muzfarpur.</i>			<i>Ludhiana.</i>	
1st April 1902 ...	Civil Surgeon ...	4	1st April 1902 ...	Civil Surgeon ...	4
	<i>Mymensingh.</i>			<i>Lyallpur.</i>	
10th March 1902 ...	Civil Surgeon ...	6	1st April 1902 ...	Civil Surgeon ...	4
	<i>Patna.</i>			<i>Multan.</i>	
10th March 1902 to 1st April 1902.	Civil Surgeon ...	24	1st April 1902 ...	Civil Surgeon ...	4
	<i>24 Parganahs.</i>			<i>Muzaffarnagar.</i>	
25th February 1902 ...	Civil Surgeon ...	6	1st April 1902 ...	Civil Surgeon ...	4
	<i>Puri.</i>				
25th February 1902 ...	Civil Surgeon ...	6	1st April 1902 ...	Civil Surgeon ...	4

Date.	No. of Prescriptions sent to the Medical Officer.	No. of bottles supplied.	Date.	Name of Presidency and Districts and date of despatch.	Number of bottles supplied.
THE PUNJAB—continued.					
Peshawar.				RAJPUTANA.	
1st April 1902	.. Civil Surgeon	4	2nd April 1902	... Ajmere. Civil Surgeon	4
Rawalpind.				UNITED PROVINCES OF AGRA AND OUDH.	
1st April 1902	... Civil Surgeon	4		Lucknow.	
Rohtak.			27th January 1902	.. Inspector-General of Civil Hospitals.	48
1st April 1902	... Civil Surgeon	4		NAINITAL DISTRICT.	
Sialkote.				Haldwani.	
1st April 1902	... Civil Surgeon	4	21st April 1902	... Assistant Surgeon, Haldwani Dispensary.	4
Shahapur.				Kashipur.	
1st April 1902	.. Civil Surgeon	4	21st April 1902	... Assistant Surgeon, Kashipur Dispensary.	4
Simla.					
16th October 1901	... Surgeon to His Excellency the Viceroy.	3			
Umballa.					
1st April 1902	... Civil Surgeon	4		Total for the United Provinces.	56
Total for the Punjab			79	Grand Total	632

(4).—STUDIES ON SNAKE VENOM AND ANTIVENENE.

In the course of the work, an officer of the Laboratory (Captain Lamb, I. M. S.), and the snake man serving here for manipulating snakes, pricked their fingers against cobras' fangs. They were injected immediately with antivenene and thus became subjects for observing the effect of the latter. A report on the first case mentioned, drawn up by Dr. Hanna and Captain Lamb, was submitted to Government with this office No. 130 of 24th/25th August 1901 (published in the *Lancet*, January 5th, 1901). These cases, as well as others observed in India, tend to prove the efficacy of Calmette's serum for cobra bites in man. Experiments made on animals by Captain Lamb and Dr. Hanna show, however, that the serum has no effect against the venom of Russell's viper.

A paper by Captain Lamb, "On the action of snake venom on the coagulability of the blood," appeared in the *Indian Medical Gazette*, December 1901; a report "On some observations on the poison of Russell's viper," by Captain Lamb and Dr. Hanna, was forwarded for publication to the Sanitary Commissioner with the Government of India, with this office No. 2136 of 12th November 1901 and another, "On the action of the venoms of the Cobra and Daboia on the red blood corpuscles and the blood plasma," by Captain Lamb, with this office No. 3461 of 3rd October 1902. A paper "Standardization of Calmette's antivenomous serum," by the same officer, appeared in the "Scientific Memoirs," New Series, No. 1.

G.—DIPHTHERIA.

Upon the request of the Director-General, Indian Medical Service, expressed in letter No. 1118 of 26th February 1902, an investigation into the value of old antidiphtheritic serum was carried out, and a report on the matter sent to him subsequently with this office No. 4377 of 23rd December 1902.

H.—LEPROSY.

Vide paper by Dr. Hanna forwarded to Government (and transmitted for publication to the Sanitary Commissioner with the Government of India) with this office No. 657 of 17th April 1901.

I.—VARIOLA AND VACCINIA.

A certain number of experiments were made in the Laboratory by Captain Lamb, I. M. S., and Assistant Surgeon Kantak, Superintendent of Vaccination.

J.—EPIZOOTIC LYMPHANGITIS.

In accordance with Government Resolution No. 6698 of 25th September 1901, Revenue Department, Captain Liston, I. M. S., investigated, together with Veterinary-Major Brodie-Mills, Principal, Bombay Veterinary College, an outbreak of Epizootic Lymphangitis in Bombay cattle. The report on this matter was incorporated in the Bombay Government Resolution, Revenue Department, No. 1262 of 22nd February 1902.

K.—SURRA.

A paper on the studies made by Captain Liston, I. M. S., in this Laboratory, "On the structure, scission and conjugation of *Trypanosomum Evansi*," was forwarded for publication to the Sanitary Commissioner with the Government of India with this office letter No. 2137 of 12th November 1901.

A certain amount of correspondence has also taken place on the manner of destroying rats—*vide* this office letter to Chief Medical Officer, Baroda, No. 1318 of 1st August 1901; letter from Fred. Pratt, Esquire, I. C. S., Ahmedabad, dated 12th January 1902; Government Resolution No. 7929 of 14th October 1901 (Revenue and Agriculture Department). No practical work on the subject could, however, be done for want of the necessary facilities.

III.

OTHER WORK OF PRACTICAL UTILITY CARRIED OUT
BY THE LABORATORY.

The above summary refers to the researches carried out in the Laboratory and to such practical benefits as resulted from the Laboratory's studies.

In addition to this, the Laboratory has done a certain amount of other work of practical utility which may be mentioned under the following heads :—

(1) Diagnosis of obscure diseases in men and animals; examination of pathological specimens; study of mosquitoes; investigation of food-stuffs, drinking-water, and of the atmospheric and subsoil air.

(2) Instruction in bacteriological work and research; facilities given to experienced investigators admitted to work at the Laboratory; supplying references, books, apparatus, bacteriological preparations and specimens to institutions and workers outside the Laboratory.

(3) Delivering lectures and publishing papers on the Laboratory's studies; and

(4) Giving expert opinion in reply to official and unofficial enquiries.

(1).—DIAGNOSIS OF DISEASES.

(a).—During the famine of 1900 the Laboratory investigated, by Government order contained in letter No. ^{39 M.}_P of 26th May 1900, the question of prevalence of relapsing fever in the Gujarāt Famine Camps. A report on the matter was submitted to Government with this office No. 1084 of 6th July 1900.

(b).—Upon the request of the Inspector-General of Jails, Bombay Presidency and of the Superintendents of Jails, relapsing fever outbreaks were investigated in the Umerkhadi Common Prison, Bombay, in December 1899; in the Thána Special Prison, in December of same year (letter from Inspector-General of Prisons, No. 7867 of 9th December 1899), and specimens of blood were examined for relapsing fever during an outbreak in the Bijápūr Jail in 1901 (letter from the Medical Officer of the Jail, No. 84 of 29th November 1901; this office report No. 2282 of 4th December 1901).

(c).—Specimens were examined microscopically and cultures made of the microbe of cerebrospinal meningitis, from material received from the Ahmedabad prison.

(d).—Apart from epidemic outbreaks, in a large number of individual cases the Laboratory officers examined specimens and gave advice to medical officers and private practitioners in connection with the diagnosis of obscure diseases in men and animals. Accurate figures cannot be quoted.

(e).—Examination of dog's brains for rabies and studies on the disease.

The Bombay Veterinary College forwarded suspected dogs' brains for examination on the following dates :

17th August 1901,

2nd September 1901,

3rd November 1901,

30th January 1902, and

21st March 1902.

That of 30th January 1902 was proved to contain the virus of hydrophobia; the brains, in the remaining cases, were infected by other microbes and the examination for hydrophobia was impossible, the rabbits inoculated succumbing a day or two after injection.

Studies on the virus of hydrophobia were carried out, for several months upon a special plan, in 1901, but had to be gradually abandoned, on account of the animals operated upon getting infected and succumbing rapidly, under the climatic conditions prevailing in Bombay, to other brain infections.

(f).—Anthrax suspected blood was examined for the Principal, Bombay Veterinary College, on his letter of 21st February 1902.

(g).—The first cases of epidemic dropsy observed in Bombay were diagnosed by Captain E. D. W. Greig, I. M. S., and reported to the Municipal Commissioner.

(g).—EXAMINATION OF MOSQUITOES.

A number of applications were received and complied with by the Laboratory for the examination of species of mosquitoes. This work was done mostly by Captain Liston, I. M. S., also by Captains Lamb and Greig, I. M. S., of this Laboratory. The assistance of Mr. E. H. Aitken, the well-known Bombay Naturalist, must also be acknowledged here.

(h).—WATER AND FOOD EXAMINATION.

(1) Under instructions from the Commissary-General, Bombay Command, Poona, the following officers sent tinned-meat for examination in the Laboratory :

Chief Commissariat Officer, Aden, with letter No. $\frac{SK\ 6}{1256}$ of 18th November 1899 ;

Chief Commissariat Officer, Karachi, with letter No. $\frac{ST}{1351}$ of 15th November 1899 ; and

Commissariat Storekeeper-General, with letter No. $\frac{SK}{1502}$ of 17th November 1899, and subsequent.

A report on the above examinations was sent to the Commissariat Storekeeper-General, under No. 999 of 20th June 1900.

(2) Examination of food-stuffs from plague-infected shops in Patiala has been referred to above (February 1902).

(3) Water samples, apart from those referred to on preceding pages under "Cholera" and "Typhoid Fever", were examined for the Station Hospital, Deesa, in regard to the water-supply intended for the use of the officers of the Oxfordshire Light Infantry, upon letter of $\frac{15th}{17th}$ December 1901 ; for Plague Officer, Ambur ; for the Ajmere Municipality ; and others.

Advice on water examination was given to several Municipal Engineers, and directions for collecting and forwarding by rail of samples of water for Laboratory examination were drawn up and communicated to a number of correspondents, as well as sterilised vessels for collecting samples distributed among them.

(i).—Investigation of atmospheric and sub-soil air in Bombay was undertaken upon an application from the Chairman, Bombay City Improvement Trust, *vide* his letter dated 16th of May 1899, and was carried out by Dr. Taylor, working in this Laboratory. A report on this investigation was published by Government (Government of Bombay Resolution No. 1483 of 14th March 1901), and copies sent to the Government of India and departments concerned.

(1).—*Teaching work and facilities for research given at the Laboratory.*

In addition to those who came to study the inoculation work carried on at the Laboratory, the following scientists and medical officers were admitted for research, or for a course of practical study in bacteriology :—

Upon orders of the Government of India :—

Professor Axel Holst, Christiania, and with him Dr. Ustwedt, Sanitary Inspector, City of Christiania (letter No. 988 of 1st July 1901 from Secretary to Government of India, Home Department).

Upon orders from the Government of Bombay :—

Dr. T. G. Gloster (Bombay Government letter No. 4382—P of 5th November 1901). Worked at the Laboratory from 8th November 1901 to 17th January 1902.

Dr. J. Kerr Muir (Bombay Government Resolution No. 1038—P of 19th March 1902). Worked till 19th April 1902.

Dr. A. Foy (Government Resolution No. 1403—P of 21st April 1902). Worked till 10th July 1902.

Surgeon-Major Omar Chowki Effendi and Surgeon-Captain Nehad Reshed Effendi, Surgeons of the Ottoman Army (Bombay Government Resolutions No. 3608—P of 2nd September 1901 and No. 1075—P of 25th March 1902).

Upon the recommendation of the Surgeon-General with the Government of Bombay :—

Dr. (Miss) Alice Corthorn (letter from Surgeon-General, No. 8706 of 20th June 1898). Worked during June and July 1898.

Lieutenant Madock, I. M. S.

Lieutenant Hooton, I. M. S.

Upon the application of the Principal Medical Officer, New South Wales :—
Dr. Tidswell, Government Bacteriologist.

The following tutors of the Grant Medical College were admitted for study upon the application of the corresponding Professors of the College :—

Mr. Kalapesi, L.M. & S., upon the application from Major Childe, I. M. S., Professor of Pathology.

Mr. Banker, L.M. & S., application from Major Meyer, I. M. S., Professor of Medicine.

Mr. Bardi, L.M. & S., application from Major Collis Barry, Professor of Chemistry and Legal Medicine.

A prolonged course of work was done also at the Laboratory by Assistant Surgeon S. V. Kanthak, Superintendent of Vaccination, referred to already, and recommended by the Sanitary Commissioner, Bombay. This officer assisted very effectively in various branches of the Laboratory work.

The following applied on their own accord for work at the Laboratory and were received :—

Lieutenant-Colonel G. H. D. Gimlett, I. M. S. (his letter of 11th February 1902), who studied the anti-cholera inoculation *technique*.

Lieutenant-Colonel Wilkins, I. M. S., Special Medical Officer, Plague Operations, Bombay, and

Dr. Christie, on Hospital-visiting duty, Bombay.

(b).—*Affording Facilities to workers outside the Laboratory.*

Cultures of microbes, various Laboratory apparatus and cultivation media (some of special composition) were supplied to Dr. Calmette, Director, Pasteur Institute, Lille; Captain Pridmore, I. M. S.; the Sanitary Commissioner, United Provinces, Agra and Oudh; Professor Terni, Messina; the Colombo Pasteur Institute; Dr. Dean, in charge of the Serum Department, Jenner Institute,

London; Lieutenant-Colonel Lyons, I. M. S.; Major Herbert, I. M. S.; Dr. Arthur Powell, Coroner's and Police Surgeon, Bombay; Civil Surgeon, Moradabad; Medical Officer in charge, Station Hospital, Umballa; Civil Surgeon, Dhárwár; Drs. Hahn and Duerek of the Munich University, recommended by a Government Resolution; Medical Storekeeper, Bombay Command; Civil Surgeon, Jhilmam; Captain Bruce Barnett, R.A.M.C., Jubbulpore; the Royal Society's Malaria Commission in India; the Bombay Municipal Laboratory; the Superintendent of Vaccination, Bombay; Dr. (Miss) Corthorn, on Plague duty, Karáchi and Poona; the Purulia anti-cholera inoculation station, and to others.

Apparatus was got out from Home for equipping the Laboratory of the Port Health Office, Rangoon, in November 1901.

Books, and also reports embodying the results of our studies, were supplied to a large number of Medical Schools, Laboratories, Scientific Societies and Scientists in India and abroad.

(3)

(a).—The following publications were issued by the Laboratory and distributed to Medical Schools, Laboratories, Libraries, Scientists and Government and Medical Officers:—

Name of Author.	Title of Pamphlet or Report.	Date of publication.
W. M. Haffkine	"The Plague Prophylactic" (British Medical Journal and Indian Medical Gazette).	May and June 1897.
W. M. Haffkine and Surgeon-Major Lyons, Bombay.	Joint Report on the epidemic of plague in Lower Damaun and on the effect of preventive inoculation there.	1st November 1897; January 1898.
	"Times of India" Press, Bombay; also "Indian Medical Gazette."	
W. M. Haffkine	The Protective Inoculation against Plague (a lecture in the Cantonment Magistrate's Office, Poona, Major-General Duncan in the chair). "Times of India" Press, Bombay.	3rd January 1898.
Do.	Experiment on the effect of protective inoculation in the epidemic of plague at Undhera, in February and March 1898. "Times of India" Press, Bombay.	April 1898.
Do.	Report on the preventive inoculations against plague in the Khoja Community of Bombay, during the epidemic of 1897-98.	10th May 1898.
W. B. Bannerman, M.D., Surgeon-Major, I. M. S.	"Experiments on Sulphur Dioxide as disinfectant for rooms."	1st September 1897.
E. L. Marsh, M.B., D.P.H. (Oxon.).	"Effect of Sulphur Dioxide on the Bacillus of Plague."	31st March 1898.
E. L. Marsh, M.B., D.P.H. (Oxon.), and Wilford Watkins Pitchford, M.B. (Lond.), F.R.C.S. (Eng.).	"Effect of Vaporised Carbolic Acid on the Bacillus of Plague."	7th June 1898.
Do.	"Further report on the action of compressed Sulphur Dioxide as a disinfectant."	30th June 1898.
Do.	"Nitric fumes as a disinfectant"	Do.
W. M. Haffkine	Covering letter to above five papers	Do.
E. L. Marsh, M.B., D.P.H. (Oxon.), S. M. O. attached to the Plague Research Laboratory.	Report on the efficiency of Perchloride of Mercury, in disinfecting solution, as application to cowdung floors, etc., Government Central Press, Bombay.	14th March 1899.
W. M. Haffkine	On preventive inoculation (Proceedings of the Royal Society, Volume 65). (Also "Lancet," June 1899.)	1899.

Name of Author.	Title of Pamphlet or Report.	Date of publication.
	Discussion on Mr. Haffkine's discourse on Preventive Inoculation at the Royal Society, British Medical Journal.	1st July 1899.
E. L. Marsh, M.B., D.P.H., Special Plague Medical Officer attached to the Plague Research Labora- tory.	Report on the efficiency of Formal- dehyde vapour for the disinfection of native dwellings, etc., Government Central Press, Bombay.	14th September 1899.
W. M. Haffkine	"On the Inoculation Statistics as report- ed from large towns." Appendix to the report of the Dhárwar Inoculation Investigation Committee. Separate reprint, Government Central Press, Bombay.	8th March 1900.
George Lamb, M.B. (Glas- gow), Captain, I. M. S.	The occurrence of Mediterranean or Malta Fever in Bombay. Government Central Press, Bombay.	1900.
George Lamb, M.B. (Glas- gow), Captain, I. M. S.	Typhoid Fever in the Natives of India: its diagnosis by means of sedimentation reaction. Government Central Press, Bombay.	1900.
W. M. Haffkine, Esq., C.I.E.	The present condition of manufacture of the plague prophylactic in the Plague Research Laboratory. Government Central Press, Bombay.	9th August 1900.
W. B. Bannerman, M.D., B.Sc., Major, I. M. S., Superintendent, Plague Re- search Laboratory, Bombay	Statistics of Inoculations with Haffkine's Anti-plague Vaccine, 1897—1900. Government Central Press, Bombay.	1900.
W. Hanna, M.A., M.B., R.U.I., D.P.H. (Cantab.), and George Lamb, M.B. (Glasgow), Captain, I.M.S.	A case of cobra poisoning treated with Calmette's anti-venom. "The Lancet."	5th January 1901.
W. M. Haffkine	"The Health of the Inoculated." "Times of India Press, Bombay."	29th June 1901.
George Lamb, M.B. Captain, I. M. S.	Some observations on Spirillum Fever as seen in the monkey (<i>Macacus radiatus</i>). "Scientific Memoirs by the Medical Officers of the Army of India," Part XII, Simla.	1901.
W. M. Haffkine	Appendix to General Burnett's Report on 4th September 1901. The Inocula- tion in the Poona Cantonment.	4th September 1901.
W. B. Bannerman, M.D., B.Sc., Major, I. M. S.	"Inoculation and the incubation stage of Plague." "British Medical Journal," 14th September 1901, also "Central- blatt fuer Bacteriologie," 24th June 1901.	
George Lamb, M.B. (Glas- gow), Captain, I. M. S.	On the action of Snake Venom on the Coagulability of the Blood. "Indian Medical Gazette," Vol. XXXVI, No. 12, December 1901.	December 1901.
Do.	"Snake Venoms: their Physiological action and antidote," lecture delivered at Nagpur, January 4th, 1902. Central Jail Press, Nagpur.	January 1902.
Do.	"On the Etiology and Pathology of Scurvy." "Lancet."	4th January 1902.
Do.	Serum sedimentation with special refer- ence to the diagnosis of Typhoid and Malta Fevers. Government Central Press, Bombay.	1902.
Do.	Typhoid Fever in the Natives of India: its diagnosis by means of the serum sedimentation reaction.	

Name of Author.	Title of Pamphlet or Report.	Date of publication.
George Lamb, M.B. (Glasgow), Captain, I. M. S.	"A further note on the occurrence of Typhoid Fever in the Natives of India." "Indian Medical Gazette," Vol. XXXVII, Feb. 1902.	February 1902.
George Lamb, M.B. (Glasgow), Captain, I.M.S. and W. Hanna, M.A., M.B., R.U.I., D.P.H. (Cantab.).	Some observations on the poison of Russell's Viper (<i>Daboia Russellii</i>). Journal of Pathology and Bacteriology, 1902, Vol. I.	
George Lamb, M.B. (Glasgow), Captain, I. M. S.	Standardisation of Calmette's anti-venomous serum with pure cobra venom: the deterioration of this serum through keeping in India.	1902.
W. B. Bannerman, M.D., B.Sc., Major, I. M. S., Superintendent, Plague Research Laboratory, Bombay.	"Scientific Memoirs," New Series, No. I. Description of the Plague Research Laboratory. Proceedings of the Royal Society of Edinburgh. Vol. XXIV, Part II.	1902.

(b).—*Lectures delivered by Laboratory Officers.*

On inoculation against the plague, by W. M. Haffkine, Poona, under the Chairmanship of Major-General Duncan, Commanding Poona District, on 3rd January 1893.

On preventive inoculation, by W. M. Haffkine. Delivered before the Royal Society, London, June 1899.

Lecture by Captain G. Lamb, on a Small Tumour removed from Scrotum, read before the Bombay Medical and Physical Society on 18th January 1901.

Lecture by Captain G. Lamb on Correspondence between Cholera and the Prevalence of Comma-shaped Bacteria in Well Waters of Gujarât, as observed during the Famine of 1900, read before the Bombay Medical and Physical Society on 18th January 1901.

The Plague Research Laboratory, delivered by Major Bannerman before the Royal Society, Edinburgh, 1901.

On the Health of the Inoculated, delivered under the Chairmanship of His Excellency the Governor of Bombay, by W. M. Haffkine in Poona on 29th June 1901.

Lectures by Captain G. Lamb: "On the Action of Snake Venom on the Coagulability of the Blood," "On Snake Venoms, their physiological action and Antidote," and "On the action of the Venom of the Cobra and of the Daboia on the red blood corpuscles and on the blood plasma," delivered on the 4th October 1901, and 21st January and 2nd May 1902, before the Bombay Medical and Physical Society and the Bombay Natural History Society.

Lectures delivered by Captain Lamb, M.D., I. M. S., at the Malaria Conference held at Nagpur in January 1902:

"Snake Venoms: their physiological action and Antidote";

"Serum diagnosis of Typhoid fever by sedimentation method"; and

"Romanowsky's Stain."

Lectures delivered by Captain Liston, M.D., B.Sc., I. M. S., at the same Conference:

"The basis for the classification of Indian Anopheles"; and

"How to collect and identify Anopheles."

(3).—EXPERT OPINION GIVEN IN REPLY TO OFFICIAL
AND UN-OFFICIAL ENQUIRIES.

The duties and correspondence connected with this work formed a large part of the Laboratory's transactions. It is practically impossible to give a summary of this matter. Some of the replies necessitated prolonged enquiries, experiments in different directions, and researches in scientific publications and periodicals. The following recorded instances are taken from the subject of disinfection.

Letter to the Municipal Commissioner, Bombay, dated 15th October 1896, in reply to his enquiry on disinfection by sunlight.

On chemical and steam disinfection: Remarks made, on the invitation of the President, Plague Research Committee, upon certain papers ("Instructions to the people") sent for consideration by the Executive Health Officer, Bombay, dated 17th December 1896.

On steam sterilisers: Letter, dated 14th January 1897, in reply to the Municipal Commissioner's enquiry.

Remarks on the directions to Disinfecting officers issued by the Bombay Municipality: Letter, dated 14th January 1897, in reply to Executive Health Officer's enquiry.

On disinfection of Railway Carriages: Letter in reply to President, Plague Research Committee, dated Bombay, 26th April 1897.

Letter, in reply to Surgeon-General, No. 587 of 23rd September 1898, forwarding (1) Report on the experiments made in the Laboratory, by Dr. C. H. Cayley, upon the effect on the plague bacillus of 10 samples of disinfectants forwarded by the Executive Health Officer, Bombay, and submitted for test by Messrs. Kemp and Company, and (2) Report on the experiments made in the Laboratory, by Dr. E. L. Marsh, on the effect upon decomposition and upon the vitality of the plague bacillus of certain chemicals forwarded by the Surgeon-General and supplied by the Lowes Chemical Co., Limited., London.

Letter No. 1784 of 18th April 1899, in reply to the Municipal Commissioner, Bombay, on the experiments made by Captain Milne, I.M.S., of the Plague Research Laboratory, on the disinfecting power of the Atlas A Preservative Fluid.

Letter No. 213 of 30th/31st January 1900, in reply to the Director-General, Indian Medical Service, Calcutta, forwarding report on experiments made in the Plague Research Laboratory by Dr. G. Taylor on the Atlas A Disinfecting Fluid as regards its germicidal action on the plague bacillus, compared with solution of 1 in 1000 perchloride of mercury.

Letter No. 1344 of 27th August 1900, in reply to the Plague Commissioner, Bombay, and letter No. 2376 of 21st December 1900, in reply to Secretary to Government, Bombay, on the disinfection of native boots and shoes by formaldehyde gas.

Letter No. 1978 of 21st November 1900, in reply to Surgeon-General, Bombay, supplemented by letter No. 2026 of 23rd November 1900, on acid perchloride and other methods of disinfection to be used in plague.

Letter No. 1510 of 23rd August 1901, forwarding report by Dr. W. Hanna, and No. 212 of 12th February 1902, to Government of Bombay, *re* disinfection of native boots and shoes by formaldehyde vapour.

Letter No. 1525 of 26th August 1901, in reply to an enquiry by Government *re* disinfection of native houses by gaseous disinfectants and the extent to which formaldehyde gas can be applied in plague disinfection. And various others.

The Officers of the Plague Research Laboratory.

The officers who contributed the largest amount of initiative and labour in connection with the preparation of the plague prophylactic were the late Lieutenant-Colonel C. J. H. Warden, I. M. S., Drs. F. Maitland Gibson, A. Mayr and N. F. Surveyor, and Assistant Surgeons R. J. Kapadia and J. P. Pocha. The disinterested help given by Lieutenant-Colonel R. W. S. Lyons, I. M. S., then Professor of Medicine, Grant Medical College, Bombay, and Major H. Herbert, I. M. S., Professor of Ophthalmology in the same College, must also be acknowledged here.

The names of the officers who contributed to other parts of the Laboratory's work have been given in the text above and are the following:—Major W. B. Bannerman, Captains C. J. R. Milne, G. Lamb, W. G. Liston, and E. D. W. Greig, I. M. S.; Drs. C. H. Cayley, E. L. Marsh, W. W. Pitchford, Miss Alice Corthorn, William Hanna, C. Balfour Stewart, G. Taylor, and E. L. Hunt; and Mr. Pansare.

The hard and devoted work of a number of subordinate officers must also be mentioned, amongst them especially that of Messrs. H. Blenman, Dattatrya Narayan Rege, Framji Rustomji Mistri, A. T. Martin, Ganesh Govind Subnis, and others.

W. M. HAFFKINE,
Director-in-Chief,
Plague Research Laboratory

Bombay, 21st March 1903.

